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Tempering by Color.

BY B. F. SPALDING.

ORNAMENTAL BLUING—METHODS OF HEATING—TEMPERING SEWING MACHINE NEEDLES—KNIFE SECTION COLORING—GAS FUEL FURNACES—REGULATION OF HEAT.

When a piece of polished iron or steel is gradually heated in contact with the air it gradually passes through various changes of color, the shades of which vary somewhat with the kind of polish and somewhat with the kind of material. This color is said to be a surface scale of oxide. Whether it is or is not is immaterial. The important question of fact is, whether it has the property of unerringly indicating the degree of heat to which the metal has been brought. This will not settle its value as a universal indication of temper, because different kinds of hardened steel are not equally affected by equal heats. When there were fewer varieties of steel than there are now in the shops this fact was not so much noticed. I remember when I first heard of it in 1854. I was tempering some reamers for Wm. H. Miller, who was the senior of the firm which afterward started the Miller Brothers Cutlery Company, of Meriden, Conn. I was drawing them by color to a fair straw. He was at that time a contractor on gun work and had his own tools to make. As he waited he asked me if I had a fine file. I said "No," and he went into the machine shop and got one. When he brought it out he took a reamer that was drawn and bore on it with the file. I asked him what he was doing, and he replied that he was trying the reamer to see if it was the right temper, and he thought it was. I said I thought the color was "the thing to go by," and he then informed me that it had been found out in the armories, where they were using a good deal of steel, that it did not always harden alike, and that the temper didn't run down alike in accaccordance with the color. This was the first I ever heard of what, but for the universal respect for Mr. Miller, I should have considered a heterodox notion, and it was not then generally accepted by much older toolsmiths than I was. Mr. Miller had been employed a number of years at Colt's armory. He commenced work when it was located in Paterson, N. J., in 1838, running a milling machine, which fed by set screws, for Wm. Ball, the inventor, who subsequently improved the machine by making the spindle adjustable up and down. The hustle and swirl of Colonel Colt's enterprise brought out or developed a great many new ideas. Among them was the bluing of pistol work for ornamentation.

The "bluing" used for ornamental purposes on various manufactures of iron and steel, and the processes for obtaining it, were described in the "American Machinist" October 2, 1890. Those processes are not generally applicable to drawing temper by color, although some of them are used for this purpose. To these I will add two others, which may be convenient to use when a blue is wanted on articles which are not to be much heated. I have not had occasion to try them myself, but the results are said to be satisfactory. 1. The first is nearly black. The work is to have a high polish and may be thoroughly cleansed with benzine. A concentrated solution of nitrate of copper is applied while the articles are slightly heated. The shade may be varied from a blue-black to a brown-black by adding more or less nitrate of manganese. The articles must be well polished and well cleaned to insure success, and may be coated when dry with thin varnish, or rubbed with oil and wax. 2. The other method is to make a solution of hyposulphite of soda, 4 ounces to 28 ounces of water. Mix this with another solution of 1 ounce of acetate of lead in 28 ounces of water. When this mixture is brought to a boiling heat the articles to be treated are dipped in, and remain until they are heated, and are dried when removed in clean sawdust. These methods may give a good color, but it is hardly probable that it will be as permanent as that obtained by the simple action of heat.

The distinction between "bluing," technically so-called, and "drawing work to color," is that the particular aim in one case is simply the color, and in the other the temper due to the color.

There are two methods of bringing work to a uniform temperature. One is to have the heating medium kept at the right point so that the work, by remaining in it, will acquire just the proper heat; and the other is to have the medium hotter than the work is required to be, and to watch the work and remove it before it gets too hot. The former way is the safest, but the latter may be the most expeditious. If a bath of lead is kept heated to the desired point, as may easily be done in one of the furnaces specially made for the purpose, it is safe to place the work in it and let it remain even after it has become as hot as the lead. The quantity of lead in the bath should be proportioned to the mass of the articles treated to avoid noticeable changes in its temperature. There is then only one thing to look out for, and that is to see thaat the articles remain long enough in the bath. In drawing the temper directly over a flame, or in any region of greater heat than the pieces are to be, there is less safety, for there comes a critical period when the pieces, having just acquired the right heat, must be removed or they will pass the danger line and get too hot. Temper may be drawn on work which is irregular in thickness even in a medium hotter than the work is to be, provided the danger line is broadened. Melted lead will not do, for it comes in too close contact with the work, as well as hiding it from observation. But by creating a hot region with a poorer conducting medium, which will delay the passage of the critical point for any length of time which may be desired, the pieces may be drawn to temper by color with all the expedition consistent with safety. The medium employed may be the heated air in an oven, or sand may be used, with the advantage of offering but slight obstruction to observation.

When the question of expense is considered it is evident that, as labor is the most important item, it is expedient to operate upon as many pieces at a time as can be conveniently handled. If, to assure safety, the process is to be prolonged there need be no loss if the amount of work is increased in proportion. If the time is doubled, compensate for it by doubling the number of pieces operated upon.

Provision must also be made for observation of the succession of colors to stop the operation when the color exhibited indicates the desired temper. The process of bluing screws by heating them with sand in a sheet iron pan shaken over a fire is one of the primitive methods used by gunmakers time out of mind,

and suggested an improvement in the early seventies to Mr. Edward Lathrop, when, instead of gun screws he had sewing machine needles to temper in

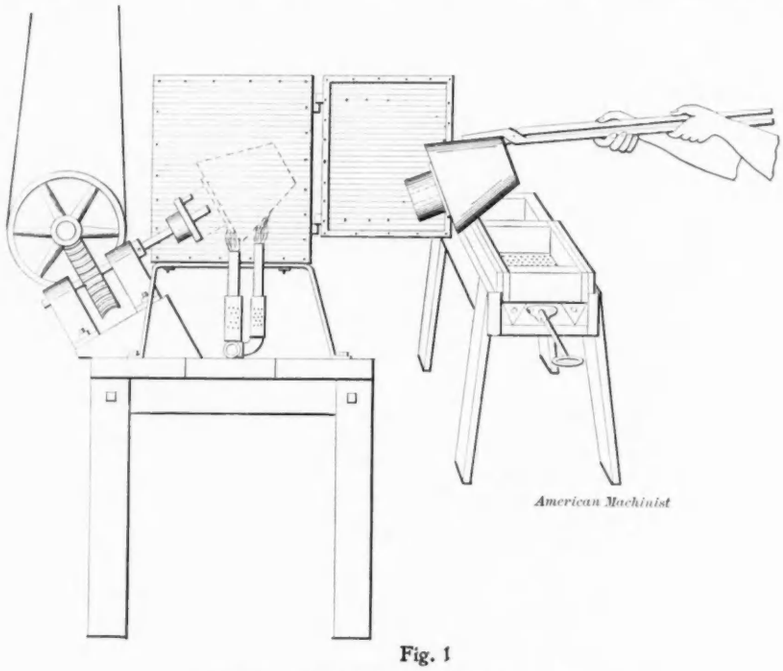

Fig. 1

TEMPERING SEWING MACHINE NEEDLES.

Worcester, Mass. The apparatus which he made for the purpose is shown in Fig. 1. It consisted of a conical sheet iron pot which revolved over the flames of three Bunsen burners. While it was heating it was in the center of a sheet iron oven. It was open at the small end, and the large end was closed and attached to a cast iron hub, which was bored out to set easily on an inclined shaft, near the upper end of which was a disk with a driving pin. This revolved the pan, and held it so that the work inside could be observed through a peephole in the oven door. When the right color was obtained the door was opened and the pot lifted with tongs from the shaft and its contents dumped upon a sieve, through which the sand fell into a box, to be returned to the pot with a new lot of needles. The shaft revolved slowly by means of a worm gear.

There is great advantage in having the work receive a regular, or at least a constant, accession of heat, or, as the workmen say, "in keeping the heat a-coming." It is difficult to take work that has been colored and bring it to a higher color. The only satisfactory way to do it is to repolish some of the pieces, and then, by observing these, the moment can be determined when the color of the others will begin to change.

The knife sections used on reaping and mowing machines are made in great numbers; some manufacturers use over a million of them annually. These are a mutilated triangle in shape, the sharp corners trimmed off, leaving the sides some 3 inches long, shape and size varying for different machines. Their value depends mainly upon their temper. Competition leaves no pains untaken to insure its quality, and economy is subserved by perfecting the methods employed to secure its excellence. Webster & Perks, at the Champion Machine Works, Springfield, Ohio, devised machinery for drawing the temper on section knives, which was operated very successfully. A frame was made with a carriage on iron truck wheels, as shown in an end view in Fig. 2. This carriage carried a tempering pot in and out of the furnace, and to do this it had a run of about 5 feet. A shaft ran crosswise of the carriage and projected beyond the side 12 inches or more, and the whole length of this projection was covered by the hub of a cast iron barrel, or pot, in which the knife sections were placed to be tempered. Some sand was shoveled in, the carriage was run along on its track and carried the pot into a firebrick furnace, the tile door closed behind it, and it was revolved at the rate of twelve times a minute until the sections had reached the proper color, as observed through a little door in the furnace, which coincided with the small mouth of the pot. When the observer found that the color was right by taking one out occasionally with a pair of long tongs through these openings, the tile door of the furnace was raised and the carriage run back, bringing the barrel outside of the furnace again. Its revolutions were now stopped and its contents discharged. It was customary to reload it again as soon as convenient in order to take advantage of the residuary heat.

The pot was quite large—30 inches in diameter and 18 inches deep—and to prevent the carriage from being overbalanced by its weight the frame had a holding down rail on the back side over the

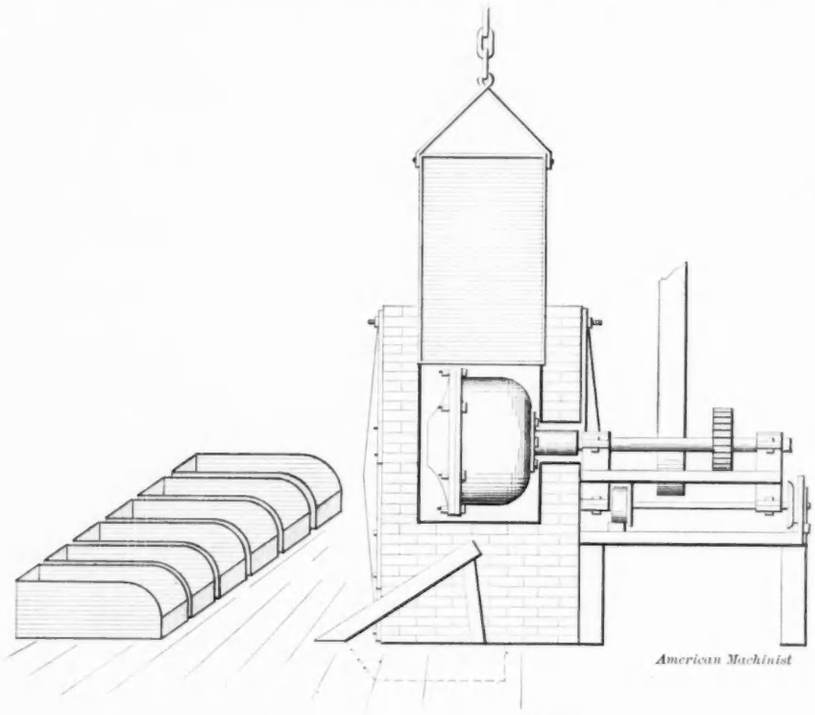

Fig. 2

TEMPERING KNIFE SECTIONS.

truck wheels. While the frame moved back and forth uniform tension was maintained on the down driving belt by an equirotal system of pulleys, consisting of

the second driver and two binders, as shown in Fig. 3.

Other details of construction may be noted as designed to meet peculiar conditions which may recur in other experience. There was a possibility that the barrel when expanded by heat might become loose on the shaft. To avoid this the hub was made in two parts; the long flanged sleeve was bored so small that to get it on the shaft it had to be expanded by a greater heat than it would get at any time in use. The real hub was also bored in the same way, and when the two were bolted together after they were shrunk on separately they had a firm hold on the shaft. So much of the sleeve was out of the fire that it was not expanded enough more than the shaft to lose the tenacity of its grip.

The head was fastened on with bolts, and as the nuts had to be worked hot they had to be loose fits in the threads. The bolts were 7/8-inch in diameter, and to get a hold that would be secure under the circumstances the nuts were made as long as twice the diameter at the bottom of the thread. The nuts were not taken off but only loosened to open the pot; the head swung aside on one bolt which was brought to the top, the other bolt holes were slotted, half of them in the head and half in the pot flange. When the bolts were loosened a hoisting rope pulled the head up to one side and held it, while the sand and sections fell upon a screen placed over a sand box beneath. The

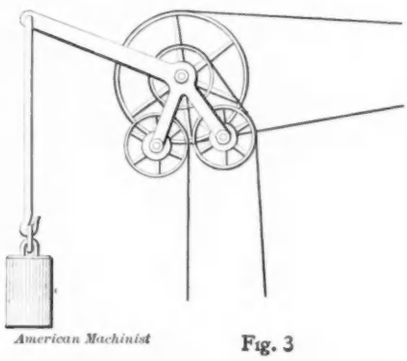

Fig. 3

EQUIROTAL SYSTEM OF PULLEYS.

sieve being placed in an inclined position the sand went through while the knives slid to the front of the bins, six of which were placed to receive the different kinds of knives, which were shoveled into them.

When the pot was emptied it stood beneath what might perhaps have been an afterthought. It was a flue, some 6 feet square and 40 feet high, up which the draft whirled the dry dust which was created by the attrition of the clean, hot sand. The dryness of a hot, dusty summer road was wetness compared to this. One may imagine arid plains and arid deserts, but no one can fancy the aridity of a mouthful of red hot sand of infinitesimal fineness. Hence the flue.

By working large lots and tempering a great many at a time the color is raised so slowly as to give time for deliberate observation, and great accuracy of temper is made consistent with great economy. Gas is the ideal fuel for purposes of regulation, and the American Gas Furnace Company, keeping up with the improvements in its use as such, manufacture a furnace with revolving trays, which are inclosed in an oven. The temperature may be higher than that which the pieces are to acquire, as the color may be observed from time to time through a doorway, and particular arrangements are made for the exact regulation of the heat so that large parts of pieces of irregular section may be brought to the right color before the small parts are overheated. The same manufacturers also make an automatic tempering and coloring machine for such work as coloring penholders. Into these machine furnaces the work is fed from a hopper at one end, and in its passage through it is heated by hot sand, which sifts down upon it until, having gained the desired shade of color, it is discharged at the other end. Both of these furnaces obtain their revolving motion by power transmitted by worm gearing. By the use of compressed air in combination in varying proportions with gas the manufacturers have a means for the perfect regulation of the heat and consequent control of operations in tempering by color.

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The Adaptability of Compressed Air.

It is easy to show in many cases that in the use of compressed air for a given purpose a large percentage of power is wasted, and yet the peculiar adaptability of air to the service insures its employment. The wide range of service to which compressed air is satisfactorily applied is evidenced in the sales of the air compressor manufacturers. The Clayton Air Compressor Works, of this city, report sales for the months of February, March and April of this year as follows: Nineteen air compressors for operating pneumatic stone working tools, chipping and calking tools, hoists, etc.; nine for moving acids and chemical solutions; four air-lift water pumping plants; three compressors to rubber works for removing hose from mandrels, testing hose and inflating tires; two for oil burning; one for the pneumatic transmission of messages; three for racking off beer in breweries; one for spraying brick in the process of manufacture, and six for unusual and unpublished applications. Four compressors in addition to the above were sent to Europe for operating pneumatic shop plants, and included in the list above were orders for the Brooklyn Navy Yard and for the Yarrow Shipyard, London, England. Another large compressor by the above firm goes to the Bath Iron Works, Bath, Me.

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An Industrial Commission.

A bill has passed the House and been introduced in the Senate having for its object the appointment of a commission to be known as the "Industrial Commission," to consist of five members each of the House and Senate, and nine representatives to be chosen as representing various industries and employments, to be appointed by the President and confirmed by the Senate. The object of this commission is to be the investigation of questions relating to immigration, labor, agriculture, manufactures and business, and to report to Congress necessary legislation upon such subjects.

It will be the object of this commission to promulgate laws that will be mutually beneficial to all classes—to the laborer, producer, employer and consumer. To further this object it may give hearings, appoint sub-commissions for the purpose of making investigations in various parts of the country.

The term of the commission would be two years, with a salary for each member of $3,600 annually and actual traveling expenses. The bill calls for an appropriation of $50,000 annually to meet the necessary expenses of the commission. It will be expected to report progress to Congress from time to time, and to make a final report at the completion of its labors. A. F. T.

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A recent report by Professor Arnold, of University College, Sheffield, England, upon a brazed copper steam pipe which exploded, throws some light upon an important matter. He found that the pipe was originally sound and well made, that the explosion was due to a gradual removal of about one-half of the zinc from the brazing, the remainder being converted into oxide, leaving a spongy and brittle mass of little cohesion. The disintegration was caused by water containing fatty acids, and these must have come from the lubricants employed in the engine. Copper pipes are thus shown to be very liable to gradual deterioration.

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The Diesel motor, of which we published an extended description recently, can now be seen at work at the Electrical Exhibition. It drives an electric generator with the armature mounted directly on the engine shaft—something that we believe has never been successfully done with a gas engine before. The motor makes a little more noise than is agreeable to sensitive ears, but, nevertheless, is decidedly pleasing both in appearance and action.

Patents.—I.*

BY JAMES W. SEE.

The special law books deal thoroughly with the subject of patents, but such books are too voluminous for use as working tools by the members of the society, many of whom have to do largely with patent matters. Again, unfortunately, there are certain matters connected with patents which are generally ignored by the text-book writers on the professional theory that they involve truisms not calling for discussion. And it is on these ignored matters that engineers and manufacturers, constantly in contact with the subject of patents, seem often to go astray. For instance, it is astonishing how often the intelligent manufacturer expresses an anxiety to get a patent on some new product so that he can begin its manufacture without danger of infringing upon other patents. The following remarks are designed to avoid discussion of controversial points; to be generally on the safer side in questionable matters; to deal only with questions on which inventive mechanics and manufacturers ought to be posted for purposes of every-day work with inventions, and to treat the subjects from the practical view of the shop, experimental room and office. The particular points herein considered may be briefed as follows:

Preliminary examinations are of merit in certain cases only.

Caveats are generally misunderstood.

Hurried applications are generally unwise.

Inventions are not easily stolen.

The first meritorious inventor prevails.

A patent is not a license.

Joint invention is often misunderstood.

Employers' rights are often misunderstood.

Change of purpose is not patentable.

Combination claims are good claims.

Aggregation is not invention.

Specific claims should supplement generic claims.

Sub-combinations are patentable.

The doctrine of mechanical equivalents inures to pioneers.

Modifications should not generally be set forth in patents.

Divisional applications are wise and often necessary.

A superior patent solicitor is not necessarily the best for all classes of cases.

The contingent fee system is generally but not necessarily bad.

Infringement cannot always be determined from the face of the patent.

The Government cannot insure the validity of a patent.

Patent copies and digests are useful tools.

Foreign patents should be contemplated with caution.

* Presented at the Niagara Falls meeting of the American Society of Mechanical Engineers.

PRELIMINARY EXAMINATIONS.

If an application is filed for a patent it may become rejected on flat references which, if known in advance, might save the entire expense of the application. Some months generally elapse between the filing of the application and the reaching of it for official examination, the inventor during this time being in doubt as to where he stands and as to the advisability of spending money in promoting the invention. Hence the idea of a preliminary examination into the novelty of the invention. In some lines of invention it is possible to look up all of the patents in that line, and thus get a general notion of the prospects. If a flat anticipation is encountered then the matter may be dropped. The expense of the preliminary examination is but a few dollars, and may be the means of saving the cost of an application and of promptly showing that no further hopes need be had. But preliminary examinations are of respectable value only when they do succeed in bringing out such flat anticipations. If they do not develop anticipating matter it does not follow that the exhaustive official examination will not do so. No cheap preliminary examination can extend beyond United States patents, thus leaving foreign patents and literature and pending applications entirely unsearched; nor can preliminary examinations contemplate with any satisfactory degree of certainty the position which may be taken by the officials as regards questions, aside from novelty, of aggregation, non-invention, etc. Preliminary examinations can be made only where the invention can be searched for in well defined classes. Where the invention is liable to be buried in non-cognate classes, or in an enormous number of classes, no reliable cheap examination can be made. Many cases occur in which it is impossible to say that anticipations of the invention should be looked for in certain classes of patents and not elsewhere. For instance, a given detail of mechanism, invented with special reference to a steam-engine governor, might be found in connection with unthought of textile machinery, or a cord guiding device for a steam-engine indicator might be found fully anticipated in some patent for the rigging of ships. By "cheap" preliminary examination I mean an examination whose low cost will justify its being made for the purpose of possibly saving the expense of an application. Even where an invention might be searched for in well defined classes, slips may occur by reason of broken sets of patents in the portfolios of the Patent Office. It has often happened that a conscientious search through a given sub-class in the Patent Office has indicated a clear field, and that the subsequent official examination resulted in a flat reference, which belonged in that sub-class and belonged nowhere else. In other words, this reference should have been found during the preliminary examination. But it has developed that the portfolio was incomplete. It is the aim of the Patent Office to keep them complete and to surround them with reasonable safeguards, but rascally searchers, with the desire to save the trifling cost of a copy of a patent, are able to abstract copies and leave the portfolios incomplete. These portfolios, altogether, contain over a half million patents, and there seems no reasonable way to insure their constant completeness. With a view to possibly saving the cost of an application, and with a view to prompt information on which to found hope or despair, it is advisable to make preliminary examination in case the invention will fit into fairly defined classes of patents, but not otherwise.

CAVEATS.

Many inventors seem to have a notion that a caveat is a provisional sort of a patent; that it constitutes title to property in inventions, and that it is a quick and cheap method for securing temporary protection. This is all wrong, for caveats fulfill none of these conditions. When an inventor contemplates the production of an invention along a given line, and where he fears other inventors might have or get, properly or improperly, similar ideas, and beat him in the race of diligence in completing the invention, he may make up a description of his incomplete invention, observing proper formalities, and lodge the same in the secret archives of the Patent Office on payment of a fee. The caveat term is one year, and may be renewed from year to year by the payment of annual fees. No patent will ever be granted to him as a result of the caveat. The filing of the caveat is no evidence that the caveated invention is new or patentable. No examination is made by the Patent Office into the novelty or patentability of the subject matter of the caveat. The caveat is utterly without effect as regards the rights of the public or of other inventors. The sole purpose of the caveat is to secure notice to the caveator in case a competing inventor applies for a patent, thus giving the caveator an opportunity to complete his invention and file his application and establish such rights as he may be entitled to. If during the caveat period an application is filed by a stranger seeking a patent on the subject matter of the caveat such application will be suspended, and the caveator will be given notice, and will be given three months in which to file a proper application for a patent, whereupon interference proceedings will be had to determine the question of priority. The caveat will not comprehend competing applications already on file before the caveat. It is advisable to have nothing to do with caveats, but to accomplish the caveat purposes by means of an application for a patent, for it is only in rare cases that matter can

be described in a caveat which cannot be put into satisfactory provisional form for the purposes of a formal application. The preparation and filing of a caveat costs nearly as much as an application; its period is but one year without additional fees; it provokes no official examination, and therefore gives no notion of the prior state of the art, and it can never eventuate in a patent. A formal application, made for mere caveat purposes, costs but little more than the caveat; it provokes an official examination into the state of the art, and thus serves to indicate whether or not its subject matter is new and patentable; it brings about the same notice and interference proceedings with any competing applicant, regardless of whether the competing application is earlier or later than the application in question; the application may be caused to eventuate in a patent if the matter is patentable and in satisfactory form; the application can be delayed within reasonable limits while the invention is being perfected, or in the end the application may be abandoned in favor of a later application for the invention in its more perfected form. An application has a further advantage in the fact that in case of interference proceedings it may give the applicant the benefit of the senior date of filing and thus throw burdens of opening proofs upon his competitor, while in the case of an application following notice under a caveat the caveator's application is bound to be of junior date. Briefly, a caveat does nothing that an application does not do, and an application does much that a caveat cannot do.

HURRIED APPLICATIONS.

Many inventors produce an invention and then seek a patent without delay, the result often being that the invention is patented in half-baked condition and must be followed up by later patents on more perfected forms, and that commercial experience may prove the invention a failure, and often the premature application results in such exposures as will preclude the later getting of patents with claims of adequate scope. The only advantage of the prompt application is that it enables an inventor to ascertain whether or not he is working in an old field. An application filed merely for the purpose of ascertaining the state of the prior art had often better be allowed to slumber while the invention is being mechanically and commercially developed. An inventor loses none of his rights by delaying his application for a patent. The law gives the inventor a period not exceeding two years in which to publicly exploit his invention before applying for his patent. He may sell the patented invention by the thousands without affecting his rights to the patent, so long as he applies for it within two years from its first publication by print or sale. During this period he may test the market and may improve his invention, and when he applies for his patent he may cover the invention in an approved form. Furthermore, the effect of the delay has been to give a later date to the patent, thus prolonging the date of its expiration nearly two years. If infringements develop during the period in question, then it may become advisable to avoid further delay in applying for the patent.

An exception should be noted regarding this matter of delaying the application. There is a class of inventions which might be called bubble inventions, or those which will sell for a short time only. Toys and advertising devices often come under this head. Such an invention, if put upon the market without patent, might provoke enterprising competitors having superior facilities and capable of getting all of the cream off of the business before the patent could be procured. Such inventions should be patented before they are exploited. Briefly, get the patent as quickly as possible if the commercial life of the invention is likely to be a short one, but otherwise delay the application, within the two year period of exploitation, with a view to having the patent embody developed improvements, and with a view to prolonging the protected period.

STEALING INVENTIONS.

Ideas can be stolen from the originator. But there is no excuse for inventions being stolen. An idea is not an invention, but is merely a hopeful conception of a possibility. The invention is the possibility reduced to form. Many men have ideas which are mere visions and which never can be given form by anybody; other men have ideas which they would be incapable of reducing to form themselves, but which could be reduced to form by others if the idea was disclosed. The mere hint or idea is of no benefit to the public, and is not the thing which the law seeks to reward. The useful invention is the thing which is recognized. It is quite common when a meritorious inventor has gotten his patent to hear numerous men say, "He stole that from me," when the fact was there was nothing to steal, no invention but merely an idea. As an example. Let A, in talking to B, suggest the high desirability of a balloon which could go to the moon, B never having thought of the subject before, and A never thinking of it again. In a year or two B, having wrestled with the subject, discloses and patents a system by which a balloon carries certain chemical charges acting in conjunction with atmospheric elements and rendering it possible to recharge the balloon with gas indefinitely so that it can go to the moon. A will solemnly assert that B stole this invention from him, when the fact was that there was no invention until B made it. Even if A was able to make the invention, he showed no disposition to do so. The law rewards him who accomplishes something instead of him who merely suggests the desirability of a certain accomplishment. Regardless of who first conceives of the desirability of an invention, he who actually makes the invention first is the one entitled to a reward. If the inventor of an idea does not wish to be beaten out of the reward let him keep the idea secret and act upon it, and, if a competitor appears to exist, diligence must be shown in order to prevail against the competitor. The idea of an invention, followed by occasional and half-hearted attempts to reduce the thing to the form of an invention will not prevail against the meritorious inventor who, though later to conceive, or even borrowing the idea, was the first to reach the goal of practical accomplishment which benefits the world.

But if an inventor has gone further than the idea, and has developed it into an invention, then the only way he can lose his rights is to keep it secret, so that he cannot prove that he had any rights. The originator of an invention who has reduced it to an actual useful invention, and can prove that fact, cannot be deprived of his rights. A competing inventor may meet him in the Patent Office with an application, or the competing inventor may actually get his patent before the meritorious inventor has applied for his patent, but if the facts are susceptible of proof the meritorious inventor, after proper interference proceedings, will be adjudged his rights and will get his patent, and the patent of his competitor will be practically void.

Briefly, then, keep ideas of invention secret, for fear a more enterprising man acting on that idea may be the first to actually evolve an invention from it; be not so secret as to exclude knowledge from friends who may be needed to make proof of dates and diligence; be diligent in reducing an idea to a practical invention; when the idea is reduced to a practical invention avoid secrecy so as to have ample proof of the fact.

FIRST INVENTOR.

In conflicts between interfering inventors, both seeking a patent on the same invention, he is the first inventor and entitled to the patent who has best done his duty by the public whose reward he seeks. This duty cannot be measured by any fixed standard, and each case must stand largely on its own merit. If an inventor has been diligent in pushing his conceived invention forward into a condition where it is in a position to advance the useful arts, he is not to be deprived of his reward by dilatory earlier conceivers, who have gone only so far as mere disclosures or sketches or drawings, or abandoned experiments or abandoned caveats. Priority of conception must be coupled with reasonable diligence. If there is no negligence on the part of the first inventor, the second inventor, though the first to reduce the invention

to practice, will not prevail. An application for a patent is construed in law to be a reduction to practice. The first inventor is, therefore, either he who first conceives the invention and follows it up with reasonable diligence, or he who conceives later than a negligent inventor and first reduces the invention to practice.

A PATENT IS NOT A LICENSE.

Many manufacturers labor under the mistaken impression that if they patent some new machine they are therefore free from the possibility of infringing on other patents. It is astonishing how common this error is, and how many manufacturers are in a hurry to get a patent, in order that they "may make the thing without danger from others." An original and meritorious patented invention may be dominated by some previous patent. A patented invention may be improved by a subsequent inventor, and most inventions are improved from time to time, but the improver acquires no rights under the fundamental patent by reason of having improved the fundamental invention. You cannot put your saddle on another man's horse, and thereby claim the right to ride that horse.

And the inventor of the improvement, having exercised the talent of invention and having advanced the useful arts, is just as much entitled to a patent for his improvement as the fundamental inventor was for his fundamental invention. It might be asked if it was not folly to patent an improvement which could not be used in view of a dominating patent. The answer is that improvement patents are often as valuable as fundamental patents, by reason of their expanding the market for the fundamental invention by increasing its capacity or lessening its cost. It is true that the owner of the fundamental patent may be the only possible customer for the improvement patent, but it often happens that the improvement is important or even essential to the financial success of the fundamental invention. Again, it may develop in course of time that the fundamental patent is invalid for some reason, and in any event the fundamental patent will expire while the improvement patent is in force.

JOINT INVENTORS.

Where an invention is the result of the joint efforts of two or more parties all the inventors must join in applying for the patent. Where an invention is the result of the effort of a single inventor he should not join with him anyone who has merely exercised mechanical skill in carrying out his instructions in developing the invention, or anyone who has joined him in a financial or proprietary capacity. In case the skilled mechanic has been called on by the inventor in developing his invention, and a doubt arises as to whether or not the skilled mechanic has or has not exercised some act of invention, doubts should be resolved in favor of the skilled mechanic having done so, and he should join in the application, the fundamental inventor securing himself by proper preliminary contract with the mechanic, and by deed of assignment under the application. Questions of personal pride in connection with patents should always give way to legal considerations of the validity of patents.

EMPLOYERS' RIGHTS.

An invention, to be patented, must be applied for by the actual inventor, and in the absence of acts constituting a transfer the patent, and all legal ownership in it, and all rights under it, go exclusively to the inventor. In the absence of express or implied contract a mere employer of the inventor has no rights under the patent. Only contracts or assignments give to the employer, or to anyone else, a license or a partial or entire ownership in the patent. The equity of this may be appreciated by examples. A journeyman carpenter invents an improvement in chronometer escapements and patents it. The man who owns the carpenter shop has no shadow of claim on or under this patent. Again, the carpenter invents and patents an improvement in jack-planes. The shop-owner has no rights in or under the patent. Again, the carpenter invents an improvement in window-frames, and the shop-owner has no rights. He has no right even to make the patented window-frame without license. The shop-owner, in merely employing the carpenter, acquires no rights to the carpenter's patented inventions. But there are cases in which an implied license would go to the shop-owner. For instance, if the carpenter was employed on the mutual understanding that he was particularly ingenious in devising carpenter work, and capable of improving upon the products of the shop; and if in the course of his work he devised a new and patentable window-frame, and developed it in connection with his employment and at the expense of his employer; and if the new frames were made by the employer without protest from the carpenter, the carpenter could, of course, patent the new frame, but he could not oust the employer in his right to continue making the invention, for it would be held that the employer had acquired an implied license.

If he could not use it, then he would not be getting the very advantage for which he employed this particular carpenter, and if he did get that right he would be getting all that he employed the carpenter for, and that right would not be at all lessened by the fact that the carpenter had a patent under which he could license other people. The patent does not constitute the right to make or use or sell, for such right is enjoyed without a patent. The patent constitutes the "exclusive" right to make, sell or use, and this the shop-owner does not get unless he specially bargains for it. Implied licenses stand on delicate ground, and where men employ people of ingenious talent, with the understanding that the results of such talent developed during the employment shall inure to the benefit of the employer, there is only one safeguard, and that is to found the employment on a contract unmistakably setting forth the understanding.

(To be continued.)

▲ ▲ ▲

Boiler Bracing.

BY W. H. WAKEMAN.

There has been some discussion among engineers in this vicinity concerning the comparative merits of "through and through" and diagonal braces. The former have the advantage of a "straight pull" directly against the lines of force acting to carry the boiler heads apart, but as they must be long in order to reach from one head to the other, it is difficult to keep them tight, and in some cases they become crystallized so as to fall apart when tested with the hammer. With the "through and through" or parallel brace there is no place for scale to collect between the brace and the shell, neither is there a large spot directly over the fire where there are two thicknesses of iron or steel together. On the other hand it is quite a disappointment after purchasing a boiler made of only one bottom sheet, so as to avoid a seam directly over the fire, to find that two diagonal braces are anchored to the shell by flat pieces of iron that cover perhaps 25 square inches each, and to that extent prevent the water from coming into contact with the shell. A wedge shaped space also is formed between brace and shell, which is very convenient for scale to lodge in. This refers to diagonal braces located below the tubes of a horizontal boiler, but such a construction is sometimes favored by boiler inspectors, because it gives more room to work in this part of the structure, although even inspectors appointed by an insurance company are not obliged to go into the shell under the tubes except in some special cases. It is universally admitted that it weakens the shell of a boiler to cut a manhole in the upper part of it, even if a reinforcing ring is added, but if the braces from both heads are made long enough to reach beyond the manhole and are then riveted to the shell it greatly strengthens this weak place, while if they are made short they must of necessity stand at a greater angle from the lines of force, and consequently the same steam pressure will cause a greater stress on them than it would if they were longer, while the

short one affords no reinforcement for the manhole.

Where several diagonal braces are used on a boiler head, they should not be anchored close together on the shell, for if the pressure, acting on a large surface on the heads, pulls on braces that are concentrated on one point on the shell it will cause a depression in this place. This point has been disputed, and in order to demonstrate it I once had a tin boiler made in this way, and when 25 pounds water pressure was applied there was a very large dent in the shell where the brace was fastened (for but one was used), thus proving that the shell does bend under such conditions. When the pressure was removed the depression disappeared, which shows that the plate is bent back and forth every time steam is raised and lowered, so that a weak point is created at this point, and this has been the cause of more than one explosion.

▲ ▲ ▲

Air Compressors at High Altitudes.

BY F. A. HALSEY.

It is of course generally understood that air compressors at high altitudes, as when at work at many mines, do not have the same capacity as when located at the level of the sea, but the law of decrease of output is not generally understood, nor is the corresponding law connecting the altitude with the power required to operate a given compressor or to produce a given amount of compressed air. It is a very common impression that the amount of compressed air produced is in proportion to the barometric pressure, and that the consumption of power for a given amount of air at a given gage pressure is the same at all altitudes. Neither of these impressions is correct. The amount of air delivered at different altitudes decreases slower than the barometric pressure, while the power required to produce a given amount of air increases with the altitude. In other words, while the power required to operate a compressor of given size decreases as the altitude increases, it does not decrease as fast as the volume of air delivered.

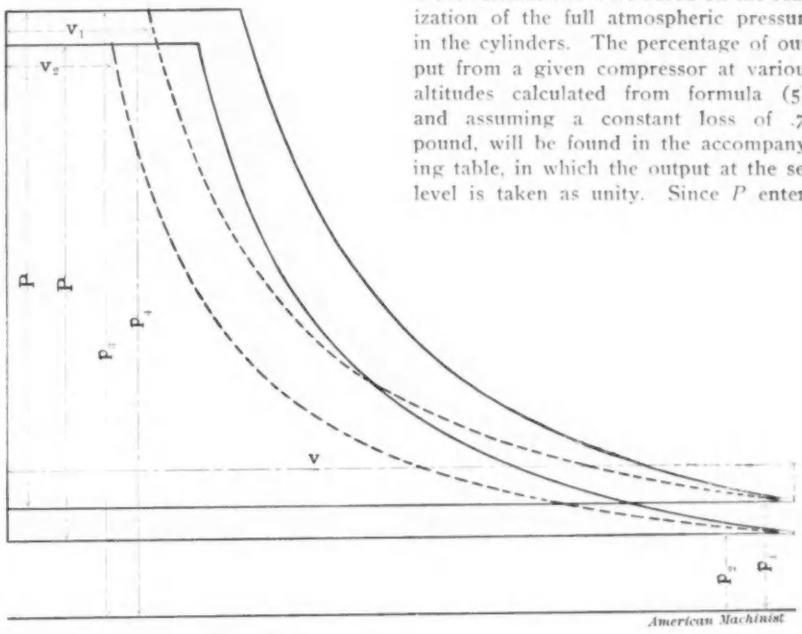
The fact that the air produced is not proportional to the barometric pressure may be easily seen by a simple numerical example. If two compressors be operated under 14 and 12 pounds initial pressure, respectively, with say seven compressions in the former case, the final absolute pressure will be $14 \times 7 = 98$ pounds, corresponding to $98 - 14 = 84$ pounds by the gage. If the second compressor is to make the same gage pressure an absolute pressure of $84 \times 12 = 96$ pounds is necessary, and the number of compressions necessary will be $^{96}/_{12} = 8$. In the former case each cubic foot of free air will produce 1-7 of a foot of compressed air, while for the latter case the figure will be 1/8. The proportionate output of the two machines will therefore be

$$\frac{\frac{1}{8}}{\frac{1}{7}} = \frac{7}{8} = .875$$

while the ratio of the barometric pressures is

$$\frac{12}{14} = .857$$

The law connecting output with the barometric pressure may be easily put into an equation. The figure represents two ideal indicator cards, taken one at the sea level with an initial pressure p_1, and the other at an altitude with an initial pressure p_2. The final gage pressure P is the same in both, and it is desired to know what relation exists between v_1, v_2, p_1 and p_2, the volumes v_1 and v_2



IDEAL AIR COMPRESSOR CARDS FOR DIFFERENT ALTITUDES.

being those shown by the isothermal curves to which the air will shrink after it has lost the heat of compression.

It is clear that

$$\frac{v}{v_1} = \frac{p_3}{p_1} \qquad (1)$$

and that

$$\frac{v}{v_2} = \frac{p_4}{p_2} \qquad (2)$$

Since

$$p_3 = p_1 + P$$

and

$$p_4 = p_2 + P$$

(1) and (2) may be written

$$\frac{v}{v_1} = \frac{p_1 + P}{p_1} = 1 + \frac{P}{p_1} \qquad (3)$$

and

$$\frac{v}{v_2} = \frac{p_2 + P}{p_2} = 1 + \frac{P}{p_2} \qquad (4)$$

Dividing (3) by (4) gives,

$$\frac{\frac{v}{v_1}}{\frac{v}{v_2}} = \frac{v_2}{v_1} = \frac{1 + \frac{P}{p_1}}{1 + \frac{P}{p_2}} \qquad (5)$$

which gives the relationship required.

As was stated in the article on the analysis of air compressor cards, it is not correct to take full atmospheric pressure for the initial pressure. At the sea level 14 pounds may be taken in the absence of exact data, and the same deduction may be made for all altitudes, since the deduction made represents the effort necessary to open the valves and fill the cylinders, and there is no reason why this should vary with the altitude. It will be seen that this constant deduction becomes of greater importance as a percentage as the altitude increases, the consequence being that the actual falling off in capacity is greater than would be found if the calculations were based on the realization of the full atmospheric pressure in the cylinders. The percentage of output from a given compressor at various altitudes calculated from formula (5), and assuming a constant loss of .75 pound, will be found in the accompanying table, in which the output at the sea level is taken as unity. Since P enters the formula as well as p_1 and p_2, the calculations have been made for two values of P, namely, 70 and 90 pounds. The difference between the outputs at the two pressures at the same altitude will be seen to be not large, and hence the two pressures selected are considered sufficient. The barometric pressures used for the various altitudes are taken from the excellent table in Trautwine's "Pocket Book." It should be explained here that the tables published in the catalogs of air compressor builders, giving outright the proportionate delivery at various altitudes without regard to the gage pressures, are intended to apply to the usual mining pressure. The difference in output due to a variation in pressure through the small range used for such work would affect the percentages of the tables too

little to be of any practical moment and is properly ignored. Refined calculations of this nature are in fact out of place in connection with compressed air installations. The speed of compressors is always variable, and a slight increase or decrease from the calculated speed takes care of all the questions which would be covered by refinement in calculation.

To obtain the mean effective pressures for various altitudes it is only necessary to make the necessary substitutions in equation (6) of the article published in the issue of March 10. This has been done, and its results will be found in the table. The two right-hand pairs of columns give the cubic feet of free and compressed air per horse-power at the different altitudes and for the two gage pressures of 70 and 90 pounds. These columns show the increased amount of power required to produce a given amount of air at an altitude, the figures giving the gradually decreasing amount elevation increases.

Altitude, feet.	Barometric pressure.		Relative output for gage pressure.		M. E. P. for gage pressure.		Cubic feet piston displacement per I. H. P. for gage pressure.		Cubic feet compressed air per I. H. P. for gage pressure.	
	Inches mercury.	Pounds per square inch.	70 lbs.	90 lbs.	70 lbs.	90 lbs.	70 lbs.	90 lbs.	70 lbs.	90 lbs.
0	30.00	14.75	1.000	1.000	33.1	38.2	6.93	5.99	1.144	.801
1,000	28.88	14.20	.967	.966	32.6	37.6	7.03	6.09	1.123	.787
2,000	27.80	13.67	.935	.933	32.1	36.9	7.15	6.20	1.103	.773
3,000	26.76	13.16	.904	.900	31.5	36.3	7.27	6.31	1.084	.759
4,000	25.76	12.67	.873	.869	31.0	35.6	7.39	6.43	1.065	.746
5,000	24.79	12.20	.843	.839	30.5	35.0	7.51	6.55	1.046	.733
6,000	23.86	11.73	.813	.809	30.0	34.3	7.65	6.67	1.028	.720
7,000	22.97	11.30	.785	.780	29.4	33.7	7.80	6.79	1.011	.708
8,000	22.11	10.87	.758	.751	28.9	33.1	7.94	6.92	.994	.695
9,000	21.29	10.46	.731	.723	28.3	32.5	8.09	7.06	.976	.683
10,000	20.49	10.07	.705	.696	27.8	31.8	8.24	7.20	.959	.670
11,000	19.72	9.70	.680	.671	27.4	31.2	8.39	7.34	.942	.658
12,000	18.98	9.34	.656	.647	26.9	30.6	8.54	7.49	.925	.646
13,000	18.27	8.98	.632	.623	26.3	30.0	8.71	7.64	.908	.635
14,000	17.59	8.65	.608	.600	25.8	29.4	8.88	7.80	.891	.624
15,000	16.93	8.32	.585	.576	25.3	28.8	9.06	7.96	.875	.613

TABLE SHOWING THE EFFECT OF ALTITUDE UPON AIR COMPRESSORS

The increased number of compressions necessary to produce a given gage pressure at an elevation lends an added value to compound compressors in such locations. The clearance loss increases with the ratio of compression, and hence, for a given gage pressure, is greater at high altitudes than at low. For example, six compressions at the sea level with an initial cylinder pressure of 14 pounds will give a final gage pressure of 69.25 pounds, while at 10,000 feet altitude the same number of compressions would give but 45.85 pounds gage pressure, and so far as clearance losses are concerned there is just as much reason for compounding for 45.85 pounds at 10,000 feet as there is for 69.25 pounds at the sea level. To produce 69.25 pounds gage pressure at 10,000 feet would require 8.51 compressions, which at sea level would produce a gage pressure of 104.45 pounds; and again, as regards the clearance losses, there is as much need of compounding for 69.25 pounds at 10,000 feet as for 104.45 pounds at the sea level. The same argument applies to the saving due to the action of the intercooler. Comparison of formula (7) of the article published March 10, giving the M. E. P. for simple compression, and formula (6) of the article published March 31, giving the M. E. P. for compound compression, will show that for a given altitude the only variable is R—the total ratio of compression—and the greater the value of R the greater the percentage of saving. Since for a given gage pressure the value of R is greater at high altitudes than at low, it follows that the percentage of saving will be greater at the higher altitudes, so that, considered from either the standpoint of reducing the clearance losses or the saving due to the intercooler, the arguments in favor of compounding have an added value as the altitude is increased.

In an economic sense the comparison is still stronger. Considering the reduced delivery of compressors at high altitudes, the increased cost of a machine for a given duty, and the increased power cost of a given amount of air, it is clear that a given percentage of loss is a more serious matter in such machines than in those located at the level of the sea, and that compounding is justifiable when its percentage of saving is less in the former case than in the latter. There can be no doubt that at the altitude at which many mining plants are located compound compressors should be used in all cases.

A Practical Experiment in Refrigeration by Re-expanded Air.

From a personal letter from E. A. Rix, M. E., who has done much excellent work on the Pacific Coast in connection with compressed air, we are permitted to make the following extract:

"I have been reading with considerable interest your articles on 'Refrigeration by Compressed Air.' I had hoped, however, to see some data on the subject; that is to say, examples of what has been done, how much air it took to do it, etc.

"I tried a little experiment the other day which might not be uninteresting. Some people who are making oil clothing for the Klondike were desirous of getting a temperature of 20 degrees below zero, in order to see how their clothing would stand it. I made a box out of zinc, 12 inches square and 2 feet long, and surrounded the same with 6 inches of anti-caloric insulating material, covering the whole over with a pine box, making a suitable opening. I introduced the exhaust from a 2 horse-power automatic Payne engine, at one end of the zinc box, and let it escape out of a 1-inch pipe at the other. I put a wooden brake on the fly-wheel of the small engine, so as to make it do all the work it could. I introduced the air into the engine at 80 pounds and succeeded in reducing the temperature of the box and the material which I put in it in a very few minutes down to 27 below zero. I am not at liberty to state the effect on the clothing, except to say that it was a bad day for some of the samples."

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Permanent gases no longer exist, as on Tuesday last [10th ult.] Professor Dewar succeeded in liquefying hydrogen in quantity at the Royal Institution, and showed half a wineglassful of the liquid to Professor Rayleigh. This experiment constitutes a distinct step in advance, as hitherto all attempts to collect liquid hydrogen have failed, though certain experimenters have, it is claimed, produced it in the form of mist. The density of the liquid is said to be about 0.6, water being unity. The boiling point at atmospheric pressure is about 240° Cent., or only about 43 degrees above the absolute zero of temperature. When a test tube is plunged into the liquid its lower portion is soon filled with solidified air.—Engineering.

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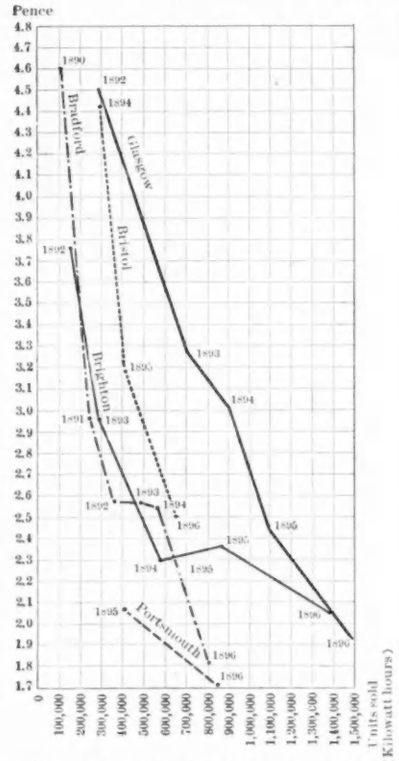
A three-ply leather belt, 80 inches wide and 165 feet long, was recently made for a Jersey City electric light and power company. No rivet, peg or stitch was used in the making, it being glued together by a special cement of unpublished composition. Four hundred and thirty-two hides were used in the belt.

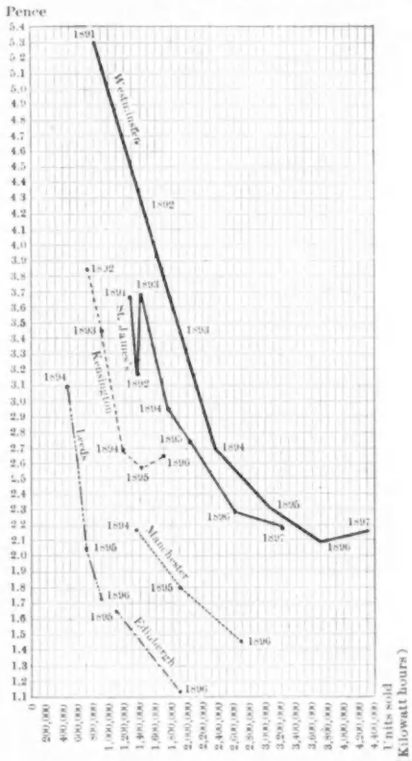
The Cost of Electricity as Related to Output.

We have received a copy of a paper read by Mr. Robert Hammond before the [British] Institution of Electrical Engineers on "The Cost of Generation and Distribution of Electrical Energy." The paper occupies 132 pages, and is a compilation and analysis of the cost of electric production by eighty-five corporations and municipalities of Great Britain. It is impossible for us to even abstract so voluminous a production, but its value to any corporation doing this work is very great. The costs are itemized under coal, oil waste and stores, wages, repairs and maintenance, rent rates and taxes, and management expenses, and



Curves showing relation between Total Costs per Unit and Units sold

American Machinist



Curves showing relation between Total Costs per Unit and Units sold

American Machinist

THE COST OF ELECTRICITY AS RELATED TO OUTPUT.

cover a series of years. One of the most striking features of the paper is the marked reduction of cost per unit with increased output. This reduction is shown by diagrams, a diagram being given for many of the works and under each of the above subdivisions, while a final pair of diagrams gives the summary of all elements of cost per unit. These final diagrams, which are self-explanatory, we reproduce herewith. It seems proper to remark, however, that the diagrams of necessity ignore other sources of economy, such as improvements in the character of the plants which have naturally been adopted from year to year. Making all reasonable allowance for these, however, the influence of increased output remains very conspicuous.

Foreign News Notes.

A sixty year concession has been granted to a British syndicate in the province of Shan-si, China, with full powers to exploit the various valuable resources of the province and with permission to construct a railroad to join the main line running from Pekin to the south, the construction of which is already begun.

There has been talk for some time of a cutlery combine in England, but the consensus of opinion is that anything like an effective combine is out of the question, for the reason that there are so many competing firms and too many varying patterns.

Motor carriages, propelled by petroleum, have made their appearance on the streets of Tokio, Japan.

It was not until last year that Japan granted rights to foreigners as to patents, trade marks and designs equal to those enjoyed by Japanese subjects. Since that time applications by foreigners have flowed in freely, and to such an extent that up to March about 10,000 trade marks, 1,000 patents and 100 designs were registered in the Agricultural and Commercial departments.

An electric railway is being constructed along the principal street of Sydney, N. S. W., for which nearly all the material is being imported from the United States.

The Pennsylvania Steel Company is reported as having secured the contract for supplying 72,224,000 pounds of rails to be used in the construction of the Siberian railway.

The returns for the first three months of the present year for British export trade show a heavy drop in exportations of metals and articles manufactured from metals, with the sole exception of machinery.

If firms in the United States interested in the manufacture of machinery and appliances adapted to the evaporation of fruits would experiment until they perfect machinery for the evaporation of bananas a ready sale would be found for hundreds of such machines in San Juan del Norte, Nicaragua, and the trade would soon be extended to all Central American countries.

British manufacturers are making the claim that Mexican capitalists are yearly recognizing the superiority of English cotton machinery; so much so that for some years past all the new machinery erected has been of English make. In factories where steam power is employed the large engines of 100 horse-power and upward are usually English, but where not so much power is required American high speed engines are preferred on account of their cheapness. The multitubular, which is the form of boiler in common use, is generally of English make.

A ready sale is found in certain parts of Russia for pumps, those of the Blake & Worthington types being best known. It may be of interest to know that, owing to their general lightness and low price, American pumps are the favorites in South Australia.

It is expected that foreign capitalists will be asked to compete, in the near future, for the construction of some contemplated branch railroad lines in Servia. She has no means of constructing these herself.

A cartridge factory has recently been opened at Rustchuk, Bulgaria.

A. F. T.

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The annual meeting of the William Cramp & Sons Ship & Engine Buliding Company was held at the office of the company in Philadelphia on May 26. But one change was made in the board of directors, and it is understood that the present officers of the company are all to be re-elected. It is stated that no discussion occurred regarding an alleged "deal" with the English shipbuilding firm of Vickers, Sons & Maxim, and that there is no ground for the rumor regarding such a deal which has been widely circulated. At this writing nothing definite is known about the matter, however, except that, if the reports of interviews published in reliable newspapers are to be credited, some very vigorous and able lying is being done by prominent men regarding the matter.

Letters from Practical Men.

Steel and Wrought Iron Forgings.

Editor American Machinist:

Noticing the review of Mr. Porter's pamphlet on wrought iron and steel forgings which appeared in your issue of May 19, I would say that I am familiar with the publication and in general believe its statements to be sound. At the same time I believe this present day worship of steel is likely to be carried too far. That steel is the superior metal for many purposes where iron was formerly used is undeniable, but I believe there are places where the toughness and reliability of iron forgings make them superior. For instance, look at the practice with locomotive frames. Certainly locomotive builders have been quick enough to substitute steel for iron wherever it is advantageous to do so; but the frames of locomotives are to-day built up from iron scrap, precisely as they were twenty years ago. Unless iron is the better material, or the locomotive builders are very blind, how is this to be accounted for?

H. D. Avery.

Philadelphia, Pa.

[The instance cited by our correspondent is the exception that proves the rule. The first principle of steel forging practice is that such forgings shall not be built up by welding, but shall be forged down from ingots larger than themselves. The shape of a locomotive frame is such that it is scarcely possible to make it by the methods that are necessary to follow with steel if good results are to be obtained. Iron, on the other hand, can be successfully worked into the necessary shapes, and it is consequently used, not because it is a better material to bear the strains, but because the only methods by which the necessary shapes can be produced are such that good steel forgings cannot be made by them.—Ed.]

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Some Points About English and American Lathes.

Editor American Machinist:

If the subject has not already been too well threshed out, I would like to add a few remarks on the compound rest question, as it seems to me that nearly all the writers on this matter have mistaken the salient point of the English method of using the compound tool rest, and now Professor Sweet, it seems to me, overlooks the good points of the four-bolt tool post.

Having been in America for a considerable number of years I cannot, of course, speak personally of the present method of using the tool post in England, but from what I gather it has altered little from what it was when I was a cub in the machine shop. With us then it was almost invariably the practice to clamp the tool on the outside of the studs on the left-hand side of the rest, or on the inside of the rest outside of the studs when using the tool parallel with the lathe bed. So the usual position of the tool was lying outside of the studs on one of the three sides of the rest, and at the opposite end of the straps (or clips as we called them) a short piece of iron was placed, and only the two bolts next to the tool were tightened down and sometimes only one of them. Again, on some lathes a separate clip was used to each stud. One end of these clips being, as in the previous case, just long enough to reach to the end of rest, and in the other was a set screw for holding that end up when tightening down on the tool. Now it seems to me, and that after a long time in this country using nearly every class of lathe made here, that that is the most convenient and handy way of holding a tool. Now compare that with the so-called American post with which you are utterly prevented from using a tool of any kind whatever with one of its sides flush with the edge of the rest; you cannot get close to the face plate with a cutting off or side tool; you always have the objectionable inch or inch and a half extra space, and there is not that rigidity with the tool held in the post that there is when it is clamped firmly onto the flat surface of the rest.

Now with these four studs and the compound rest it does not matter how the slide stands; they are equally convenient any way, because the clips can be placed over any pair of studs, or in the case of individual clips they can be swung round in any direction that may be desired.

I have in my laboratory a 16-inch lathe, considered to be one of the best makes in this country, and it is undoubtedly a good tool, but the compound rest is practically useless on account of the cumbersome shape of the footstock, which entirely prevents its being put round to any considerable angle when on short work, and it cannot be put round parallel with the lathe bed when the footstock is in use. The cross slide is so narrow that to get any rigidity at all it must be gibbed up so tight that you cannot move it. Another point, the hole in the live spindle is necessarily much larger than that in the tail spindle, but instead of fitting the center in the live spindle with a collet so that the tail center could be turned up, the center in the live spindle is solid. Again, there are no less than three interferences. The handle of the compound rest interferes with the cross slide handle, the cross slide handle is so near the clutch knob that it requires a considerable amount of education before this can be used without starting the traversing gear. It also has what is very convenient, reversing gear in the apron, but you cannot cut up to a shoulder and then reverse with this arrangement, because when the reversing handle is thrown over the saddle of the lathe jumps forward or backward, as the case may be. Then, in common with most lathes, the power feed is driven by a narrow belt, and that at such a slow speed that it is in a chronic state of slip. Now all these points which I have enumerated go a long way to hurt the sale of machine tools sent from this country to England and do much to make them disliked, although they possess numerous excellent features better than the English lathe.

There is one other point of difference between the two lathes which I would like to draw your attention to, and that is that a great majority of the lathes made in this country have the headstock secured to the lathe bed by bolts that are too small. I have a 16 inch lathe with one-half inch bolts. Now the ordinary English lathe of the same size will have its headstock held down with two bolts of at least 1 inch diameter.

Frederick Hart.

Poughkeepsie, N. Y.

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An Error of the Sang Theoretically Perfect Gear Tooth.

Editor American Machinist:

Considerable attention is being paid just now to the methods of cutting gear teeth by originating the tooth forms, but no one seems to have seen—certainly have not recently called attention to—a practical error in the application of that theory. I showed this error in the issue of the "American Machinist" for May 1, 1890, and reproduce here Fig. 19 and the accompanying text of that paper. It is

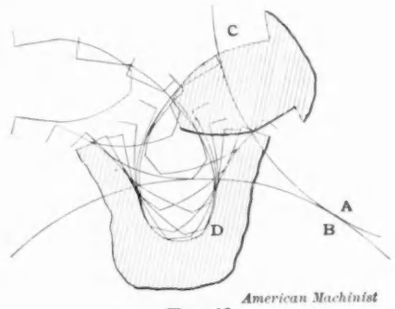


Fig. 19

GRAPHICAL MOLDING OF GEAR TEETH.

also clearly shown at page 11 of my "Treatise on Gears." This theory and the methods depending on it were invented about the year 1850 by Sang, an Englishman, then serving as an officer of the Turkish army, and it is destined to be the chief means of cutting gear teeth in the near future. The "octoid" or Bil-

gram process, the "planoid" or Grant process, the recent processes of Fellows, Warren, Gleason, and others, all depend on it directly or indirectly.

On account of the fillet that is formed by this process the tooth space cannot be used with a mating gear having more teeth than that of the forming gear, although it belongs to the same interchangeable set. The tooth space of the figure will not run with a tooth on a pitch line larger than the pitch line *A*.

Therefore the rack tooth must be used as the forming tooth to allow of the use of all gears of the set up to the rack. Gears of the set thus formed will not work with internal gears.

The figure shows a forming tooth, or tool *C*, cutting a tooth space *D* in a gear blank, and the various positions of the tool in the tooth space are shown by the unshaded lines. Notice that the outline of the bottom of the tooth space—that is, the "fillet"—is formed by the corner of the cutting tool, while the tooth curve is formed by the curved side or tooth curve of the tool. This leads to two sources of error.

First Error—The bottom of the tooth space is shaped to the *greatest fillet that will allow the point of the mating gear to pass*, and that fillet will not allow of the passage of the corner of any wider tooth —that is, will not allow of the passage of any tooth larger than the originating tooth. This confines the interchangeability of the set with which the gear being cut will work to gears of the size of the forming tool or smaller. In other words, if a gear is cut with a forming gear having twelve teeth it will work only with gears having twelve teeth or less. This error is small, and probably the trouble is not of practical importance for gears approximating to the number of teeth of the forming gear, but it will certainly show itself when that number is largely exceeded. If a gear is cut with a forming gear of twelve teeth it may and probably will work very nicely with gears having from twelve to twenty teeth, but the error will continually increase, and an agreement with larger gears or with a rack, or particularly with an internal gear, cannot be expected until the two have been forced together and run enough to wear off the error. The statement, therefore, that gears cut by a single forming cutter are interchangeable is subject to a practical limitation, and the set cannot be, as often stated, of "theoretical accuracy," even if the tool and the machine are both perfect.

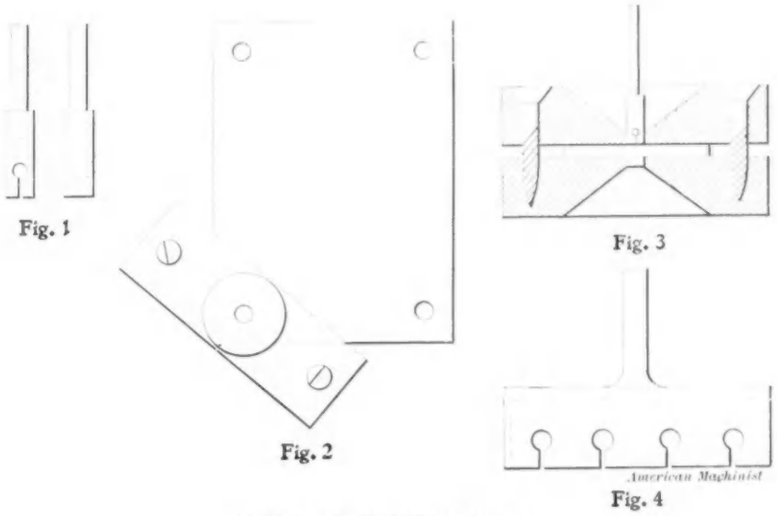
Second Error—The corner of the cutting tool does much the greater part of the work, and acts as a gouging or stocking tool at the same time that the curved edge is acting as a finishing tool, a condition of things that can hardly be expected to result in workmanship of theoretical accuracy. GEORGE B. GRANT.

Drilling Glass.

Editor American Machinist:

I have had on several occasions holes to drill through flat pieces of glass, and as I have seen men not accustomed to this kind of work put to some trouble by such a job it may be useful for those who do not know any more about it than I did when I first tried it to understand how to accomplish it. I have drilled holes through glass from ⅛ to 2 inches in diameter, and I think they could be cut as much larger as would ordinarily be needed by this method.

I make a drill or lap by driving a piece of wire into a short piece of brass pipe, or if I do not have pipe of the right diameter, by turning up a piece of brass rod and drilling a hole in the end of it, so that it answers the same purpose as a pipe with a wire in it. I drill a hole across the pipe and saw into it, as shown in Fig. 1. Then take two pieces of wood about 3 inches wide and ⅞ inch thick of sufficient length to take the piece of glass or that portion of it near which the hole is to be cut and clamp the glass between them, as shown in Fig. 2. We will suppose we have a rectangular piece and wish a hole in each corner. Fig. 2 shows the way I arrange the clamp.



TOOLS FOR DRILLING GLASS.

In making the clamp, after getting the two pieces of wood of the right size, I fasten them together with two well fitted wood screws, which act also as dowels, and drill a hole clear through them, at a convenient place, the size of the drill or lap I use for the glass, and then counterbore each in the manner shown in Fig. 3.

The glass is now clamped between them so the hole will come where desired. The drill is put in the chuck of a drill press, one of the many forms of "sensitive drills" is handy, as the spindle can be raised and lowered easily and quickly, and the glass with clamp placed on the table, so the drill will enter the hole in the clamp and rest upon the glass. The counterbore or basin around the drill is now partly filled with emery and water of 90 or 120 grade and the drill started up, not running fast enough to throw the emery. The drill must be raised and lowered frequently to allow fresh emery to flow beneath it. After going about half way through, as near as can be judged, remove the glass from the table and pour the emery and water from the basin in clamp, turn the glass over and place the drill in the hole in the opposite jaw of the clamp, putting emery and water in this basin.

The hole can be cut through from one side, but the glass upon the side the hole comes through on will flake off; by cutting from both sides this is prevented, and the edges will be clean and sharp.

The counterbored basins around the drill keep a constant supply of fresh emery at the end of the drill, a very necessary requirement to quick cutting. A hole from ⅛ to ½ inch diameter may be cut through ⅛ inch of glass in four or five minutes.

I have used this form of drill in an ordinary hand or breast drill without the least trouble, holding the clamp with glass in it in a vise. For holes of 2 or 3 inches diameter I solder a brass disk with a stem on it, for holding in a chuck, into a piece of brass pipe of the proper diameter, drilling a number of holes through the pipe and sawing into them, as shown in Fig. 4. MACHINIST.

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Bending Small Angles.

Editor American Machinist:

Certain sheet iron casings had the corners formed of 1½x3-16 inch angles, to which the sides were riveted. The angles were bent to shape when used in casings of circular form.

The method employed in bending these angles was to first cut them to length, lay out the rivet holes, which were 27-64 inch in diameter and about 5 inches apart, from a standard rod and punch them.

Two such angles were bolted together throughout their entire length, thus forming a thick webbed ⊥. These ⊥'s were run through an ordinary set of rolls, as shown by Fig. 1, and bent to the required radius. The object in bolting them together was to prevent the angles from spreading or twisting, as would happen if a single angle were put through the rolls, even if one of them were cut out as per Fig. 2.

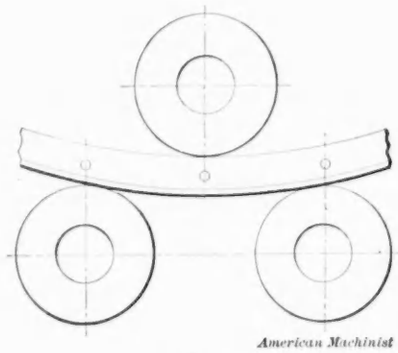

Fig. 1

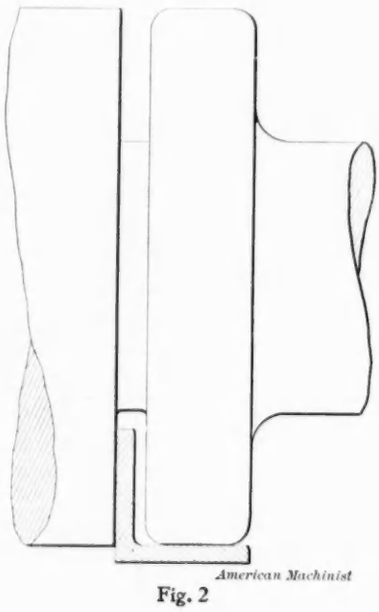

Fig. 2

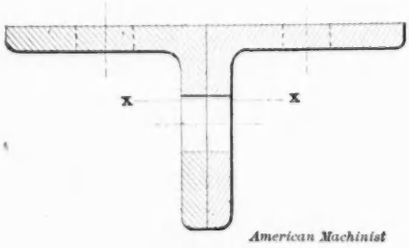

Fig. 3

BENDING SMALL ANGLES

As the ⊥'s were usually bent with the flanges on the outside, as shown by Fig. 1, the result of bending was to slightly stretch the flange and outer portion of the web and to compress the inner portion of the web. This compression made the distances between the rivet holes so much shorter that another set of rods were required in spacing the sheets to match the angles. Standard forms had templates for marking off the sheets, but special work had to be laid out. The rivet holes were spaced from the different rods accordingly as the form was rectangular or circular in shape.

By some mischance the rods for giving spacings of bent angles were mislaid, which caused considerable trouble. The method of bending the angles to shape, laying them on the sheet and marking through, while accurate was too slow. The formula giving the neutral axis of ⊥'s did not seem to meet the case until it was observed that the webs of some ⊥'s, rolled to a very short radius, appeared to be bent in a series of angles from hole to hole, indicating that the metal around the inner edges of the holes had been compressed to such an extent that the ⊥ could be considered as having a web terminating at x x, as shown in Fig. 3.

One or two trials demonstrated the depth of this web to be about 9-16 of an inch, or near the outer edges of the holes, with a neutral axis of .15 of an inch from the outer edge of the flange.

Taking a ⊥ which, for a distance of 21 holes, measured when straight 105.25 inches, and bending it to an outer radius of 28 inches, we have by calculation a distance of 102.98 inches for the 21 holes and by measurement 103 inches. Again another ⊥ of the same length, bent at an outer radius of 8 feet, measured when bent 104.56 inches and by calculation should measure 104.59 inches.

These results were sufficiently close for all required purposes. It is evident that a few experiments would give the necessary data for finding the neutral axis of other sizes of angles which were punched and bent in a similar way.

WILLIAM SANGSTER.

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Surface Necessary to Sustain Pressure.

Editor American Machinist:

You doubtless have well learned the fact that nothing in the columns of the "American Machinist" is too minute to escape the attention of some of its readers, and that no mechanical heresy, whether presented in word or in picture, can be allowed to go unchallenged. It comes quite naturally in my way to say a word or two about the step of that oil extractor shown in your issue of May 12, because at one period of my existence I looked on at the development of a centrifugal machine which has since come into extensive use, and in connection with it I learned very thoroughly the lesson that to sustain the pressure between the surfaces of running machinery those surfaces must be of sufficient extent. I took an earlier lesson on this subject long before I ever knew, intimately, a centrifugal machine. It will scarcely be credited, still I venture to tell it, that a firm which later became most extensive and successful builders of steam tugs for river towing, in the first boat which they built forgot or ignored the necessity of a thrust bearing. Only a short run of the engine at the dock, however, asserted the end thrust of the propeller shaft in terms which could not be misunderstood. It happened that the engine had a solid crank, with the pin of the same diameter as the shaft, so the end projecting through the forward bearing suggested a convenient and proper place at which to meet and overcome the thrust of the propeller. The shaft, which was probably 6 inches in diameter, was bored a couple of inches deep and not over 2 inches in diameter, and a hardened steel plug, with a spherical face projecting, was set in. A bracket was fastened on in front of the engine bed with a corresponding spherical faced steel plug in that, and that arrangement was tried. Of course, it began cutting in no time, and as the pieces were not keyed they began to cut on the outsides, too, by slipping. Then they were keyed and the bracket was changed to a pocket, so that the steels would run in oil all the while. The spherical faces cut so soon and so badly that then the hint was taken that more surface was required to meet the pressure. The ends of the plugs were then made flat, so that the full diameters of each were in contact. The engine then was run for an hour or two, and everybody was encouraged, but then they seized and welded together and sheared the keys off and tore the holes quite badly. I never saw, I think, a more complete and perfect welding of steel than that was, and I have thought that some practical use might be made of that means of welding steel. The entire end surface of the shaft was used after that for the thrust bearing with considerable success, and in boats built later ample collar surface was provided on the shaft abaft the engine.

It was quite a coincidence that a few years later I saw a similar experience gone through with on centrifugal machines. They began just where the builder of the extractor shown in your issue of May 12 has begun, with spherical surfaces and practically only a single point of contact. It did not take very long to get to flat surfaces the full diameter of the spindle. With the load which these spindles carried even this did not give surface enough, and cast iron caps were made and fitted on the lower end of the spindle, giving more than double the area, and a hardened flat steel disk was fitted with a cross groove and tongue to

revolve with the spindle. Below this there was a loose flat disk of white iron, or malleable iron before it is annealed, which is about the hardest material I ever saw, and a bronze disk, which was not expected to turn, was below this. All the surfaces in contact were flat and of as large a diameter as could be got in. They each had a cross oil groove, and there was a central hole in each piece with channels in the step, allowing the oil to circulate freely and constantly. These machines now run constantly, and the step gives no more trouble than other parts of the machine. In the oil separator referred to this one point can also be easily changed if experience with it is such as I think is more than likely to occur, and then the machine cannot fail to soon pay for itself in any establishment where it finds a reasonable amount of employment.

From the many exhibitions which we have of incorrect and unsatisfactory practice it seems well to occasionally reiterate the necessity of providing sufficient bearing surface, as in the many particulars involved in successful practice, such as correct alignment, which means only an equitable distribution of the pressure over the available surface, the material of the rubbing surfaces, the lubricant employed and the means for constantly applying or circulating the lubricant, the running speed, etc., the requirements of sufficient bearing surface seem to be transgressed more frequently than any other. Even where ball bearings or roller bearings are employed there is quite a tendency to ignore this important and insistent requirement, so that it is well to do what we can to keep it in sight.

TECUMSEH SWIFT.

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Center of Gravity of a Crescent.

Editor American Machinist:

The trial method of finding the center of gravity of crescent shaped counterbalances on locomotive driving wheels is sometimes inconvenient, and a formula which can be easily applied would often save much trouble and at the same time give more accurate results than the trial method.

In the following discussion:

A = area of segment bounded by the arc of the smaller radius, and the common chord.

A_1 = area of segment bounded by the arc of the larger radius, and the common chord.

A_2 = area of crescent = $A - A_1$.

C = the common chord.

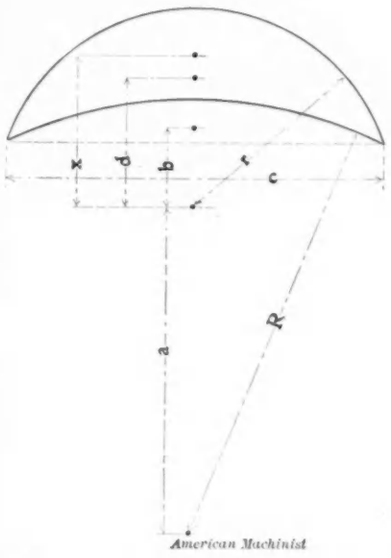
For the sake of convenience measurements will be given to the center of the smaller radius.

d = the distance from this point to the center of gravity of segment A.

b = the distance to the center of gravity of segment A_1.

x = the distance from the same point to the center of gravity of the crescent, which distance we are seeking.

a = the distance between the centers of the two arcs.



CENTER OF GRAVITY OF A CRESCENT.

By equation of moments,

$$A\,d = A_2\,x + A_1\,b, \text{ or } x = \frac{A\,d - A_1\,b}{A_2}$$

From the center of gravity of a segment of a circle to its center is

$$\frac{C^3}{12\,A}$$

This formula is given in handbooks and is easily proven. This value, referred to the center before mentioned, gives

$$d = \frac{C^3}{12\,A}$$

and

$$b = \frac{C^3}{12\,A_1} - a.$$

These values inserted into the above formula give

$$x = \frac{A_1\,a}{A_2}$$

When great accuracy is required the areas may be computed, but for ordinary purposes they may be measured with a planimeter.

In the latter case the result given by the formula will probably be at least as accurate as the trial method will give.

WILLIAM E. NINDE.

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A Spiral Planing Job.

Editor American Machinist:

The accompanying sketch shows a rush job we once had that may be of interest to your readers. The job was to plane thirty-four spiral grooves in a brass roll 6 feet long, 11 inches diameter. The roll was 5-16 inch thick, with heads cast in, a 2 inch shaft through it, with journal on each end, and on one end a place also for a driving gear. The spiral grooves were ⅛ inch wide and ⅛ inch deep, half round at the bottom, and the amount of twist was 2 inches each way from a straight line at the center, see Fig. 2. It was not necessary to cut a true spiral or the cheap rig used would not have answered. This rig consisted of a bar bolted to the side of the planer and inclined to suit the pitch of the spiral to be cut, and an arm on the shaft of the roll which rested on this inclined bar and moved up and down as the planer platen moved back and forth. There was a gear with thirty-four teeth keyed true on the shaft of the roll, and the point of a screw tapped in a lug on the side of the lever went into a space between two teeth of the gear, changing to the next space for the next groove to be planed, and so on all around the roll. The arm traveled up the incline for the cut and the weight kept it down on the return. The job was cheaply and quickly done.

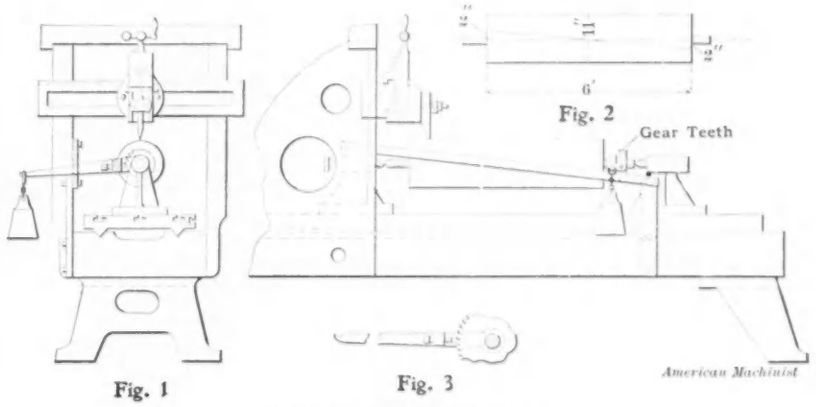

Fig. 1 Fig. 2 Fig. 3

PLANING SPIRAL GROOVES.

W. A. GOWEN.

Portland, Me.

Water-Tight Pits for Machine Tools.

Editor American Machinist:

I notice in the "American Machinist," May 12, that a correspondent wants to know how to make the pits for his large machine tools water tight. He should cover the outside of the walls first with cement and then with a good thick coat of asphalt. If the water is liable to penetrate the floor asphalt should also be used there. I have seen the asphalt covering used for the outside of arches of masonry where a considerable depth of earth, presumably damp, was afterward filled in above, and the practice has seemed to be quite satisfactory.

MORRIS FULTON.

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Water-Tight Pits.

Editor American Machinist:

Referring to the inquiry of your correspondent for a method of making pits in the ground water tight, I once saw a troublesome case of this kind in which the superintendent had taken the bull by the horns and had lined the pit with a boiler iron tank. The efficacy of the plan is self obvious, as also is the necessity of anchoring the tank in position to prevent its floating on the water.

C. O. GRIFFIN.

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The R. Hoe & Co.'s Dividing Wheel.

BY JOHN RANDOL.

The very closest machine-shop approach to accuracy in gear cutting and cylinder turning is demanded in the construction of the modern "web" newspaper printing press, in which paper is used from several rolls and printed on both sides and turned in its course so as to "associate" a certain number of four-page or four-page and two-page sheets, printed on both sides, correctly with each other on the collecting and cutting-off cylinder, where the sheets forming a complete paper or complete section of the paper are finally separated from the continuous webs by a knife working from the inside of the cylinder. All this is done at a surface speed of the paper web of perhaps 800 feet per minute, there being no "tapes" or other guides to keep the paper running straight beyond the truth of the machine work. There may be perhaps as much as 75 or 100 feet of some of the webs in the press at once, and these webs must always, all of them, be carried over or under cylinders or stationary "turning bars" every few feet, over two hundred spur gears being employed in the largest Hoe presses to do the work. The paper has very little strength and very little elasticity, and any measurable difference from correct roll and cylinder diameters or in gear-tooth spacing would result in tearing or misplacing the paper webs. In point of fact there are other seemingly insurmountable difficulties in the way of running web presses as they are now run in the pressrooms of all our important dailies; but first of all the webs of paper must be handled at exactly the same speed, and mechanics will well understand what perfection of lathe work and gear cutting is required to make all these webs of paper go through their complicated evolutions and come out associated so as to "register" at the head and foot of the printed portion of the sheets, as they do, so as to leave an even top and bottom margin on all the associated sheets when the cutting-off blade has done its work.

In the slower "bed and cylinder" presses accurate gear cutting and cylinder sizing are required, as the reciprocating bed and the revolving cylinder surface must have precisely the same

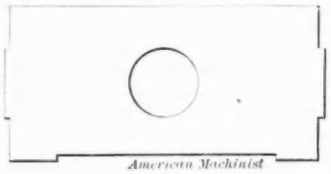

Fig. 1

PRESENT FORM OF SECTIONS.

surface speed, or a 'slur" is produced where the impression ends on the printed sheet.

Very few printers are at all aware of the degree of machine work accuracy required to print a paper on a web press, which is so rapid in action that the eye cannot separately follow the delivery of the pasted, cut, folded and counted papers as they come from the delivery mechanism at the rate of 24,000 complete copies per hour.

The ordinary printer naturally believes that any machine finished metal surface is true and perfect, accurately round if it is lathe work, or a true plane if it is planer work, and has not the faintest conception of the labor and care required to produce a successful web-printing machine. In fact most machinists are inclined to regard all printing presses as only moderate in their demand for accuracy, having a general idea that a printing press must "come round right" at some certain points, but that almost anything will run so far as the rest of the time is concerned. Nothing could be further from the truth. There is perhaps no other machine made which must have such perfect unison of action through such great distances as a web perfecting printing press. As all of this accuracy is impossible without correct gear cutting, certain examples of their gear-room practice, which the celebrated firm of R. Hoe & Co. very kindly permit to be printed from their gear cutting department, possess great interest.

The first Hoe gear cutter came across seas from Whitworth. Fine-toothed gear-cutting mills were used in those days, and this Whitworth machine (still in commission, though long since modernized) had no feed whatever, except gravity. The vertically sliding cutter-spindle carrying head was pulled up by a rope passing over a pulley until the cutter was above the gear-blank rim, and held there while the blank was indexed and then carefully lowered until the cutter was fairly in work, after which it was abandoned to its own devices until the cutter was carried through the gear rim by gravity. This practice, barbarous as it now seems and destructive of even the fine-tooth cutters used in old times, as it undoubtedly was, endured for a long time, and yet was long ago replaced by an entirely automatic feed, stop, return and index mechanism on a plan designed in the Hoe shops some twenty odd years since, and believed to be among the first, or perhaps the very first, of full automatic gear cutter devices.

The index wheel on this Whitworth gear cutter was supposed for a long time to be perfectly accurate in its spacing. In point of fact it was a long way from that, but Whitworth's name made it blasphemy to doubt, until one day a careless helper bumped this cast-iron dividing wheel rim with a heavy iron bar and bent it. It was straightened up and kept at work, but after the accident it was supposed not to be so perfectly and absolutely true any more, and every trouble in starting a new press was laid to that wheel, and so the Hoe shop decided to originate a dividing gear, and spare neither time nor money in making it as perfect as could be produced by the hand of man.

After most careful discussion of many proposed plans of procedure it was finally decided to make 180 cast-iron pieces of

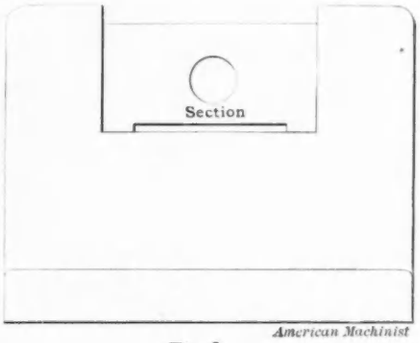

Fig. 2

GAGE TO WHICH ORIGINAL SECTIONS WERE FITTED.

the shape shown in Fig. 1, scraped to exactly fit a hand jig, as shown in Fig. 2, and then to turn up a cast-iron wheel having a radial flange to which the sections could be screwed, and a circumferential ledge, upon which the feet of the sections could stand, this circumference to be made of such diameter as would make the 180 pieces exactly fill the circle when they touched each other on the sides.

Each of the 180 sections had a screw hole through it, and each one had a screw clamp or "strap," as a lathe or planer hand would call the piece, and a screw tapped into the wheel-rim to enable each clamp to hold its own section down on the ledge, while the screw through the

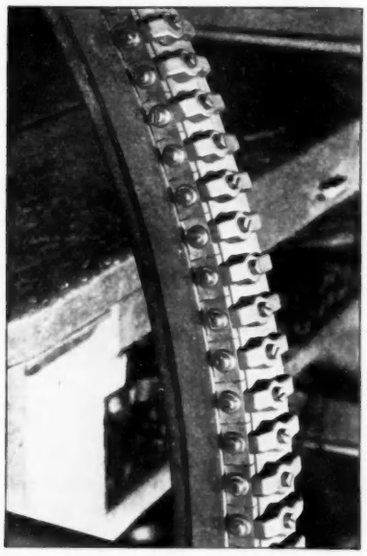

FIG. 4.—PORTION OF WHEEL SHOWING METHOD OF HOLDING SECTIONS.

section held it firmly up against the radial flange.

All records of the construction of this dividing wheel have been lost. Even the carefully hardened and ground jig to which the sections were each laboriously fitted by scraping has disappeared. The wheel, shown in Figs. 3 and 4, from photographs, is about 63 inches diameter over the tops of the section clamps. The separate sections are about 3-16 inch thick only, and are now of different outline from their original shape, as will be presently explained.

To use this dividing wheel it is placed on a special milling machine having a horizontal arbor, so that the plane of the wheel is vertical, and two index slides, having tapered ends, are inserted in vacancies produced by removing two opposite sections, 180 degrees apart, bodily from the dividing wheel, and very carefully seating the two indexes at first, so that both indexes exactly fill the vacancies in the wheel. At first only one section was removed at a time, and only one indexing slide was used. But this method was thought to be faulty, and now, on the high occasions when this dividing wheel is used, two sections are removed at once, as stated, and two indexes are inserted. It is needless to say that the very greatest care is indispensable to cut a perfect reproduction of the spacing of this dividing wheel. Every section on the wheel has to be taken off and replaced twice to make a complete revolution; the magnifying glass is in constant use, temperature must not vary much, cutters must be sharp as razors, and in general it is a job for a grown person to make a transfer of this dividing wheel. It is believed at Hoe's, however, that many perfect transfers of this wheel have been made, and that, in general terms, the transfer from a dividing wheel can be made as nearly accurate as the original is.

This wheel was very costly in time, and when not in use it is wholly inclosed in a circular wooden case and carefully suspended from the ceiling of the tool-making room close to a wall, the plane of the wheel being vertical as it hangs in solitary state.

This original dividing wheel is believed to be absolutely true, in a machine shop sense, and to have no measurable variations in its spacing at this time.

It has not always been so, however, although it successfully passed all the tests applied when it was first completed. Some years ago it was discovered that either the sections had grown larger or the circumferential diameter of the ledge on which the sections stand had grown smaller. An endeavor was made to correct the discrepancy by rubbing the ends of the 180 sections down to a smaller over-all dimension on a cast-iron emery lap-plate, making the end measure exactly fill a smaller jig to secure uniformity. Too much was removed, and the foot ledge on the wheel was reduced in the lathe with the utmost care to secure concentricity of the hub-bore of the wheel and the foot ledge. At this time, also, the end bearings of the sections were changed from full end length to

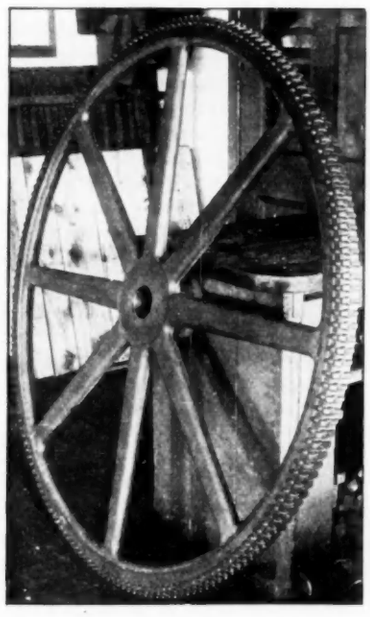

FIG. 5.—THE HOE DIVIDING WHEEL.

about ¼ inch or ⅜ inch in the middle, as shown in Figs. 1 and 4. It seems more than likely that the variation was caused by the shrinkage of the cast-iron wheel rather than by the elongation of the space sections, but the tool maker in charge of the alterations described asserts that the sections grew longer and the wheel ledge diameter remained unchanged.

All the index wheels in the Hoe shops have been copied from this original, which is believed to be faultless.

Although this seems at first sight to be a not very expensive method of producing an original dividing wheel, a careful analysis of the construction will show that it demands a great deal of the most careful hand work which can be done, and that temperature variations must be very carefully avoided, both in original construction and in using this wheel.

Taken altogether the Hoe dividing wheel is certainly one of the most remarkable in existence. It is believed to be the only one of its kind ever made, and its construction and manner of use will undoubtedly arouse much interest among tool makers, although a brief notice of it has been previously published.

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A new process of joining up the separate tubes forming a cycle frame has been in use in Germany for over a year, and is now being demonstrated in this country at the offices of Messrs. Merck, Weiser & Co., Throgmorton House, 15 Copthall avenue, E. C. On this system brazing is entirely dispensed with. The sockets are bored a forcing fit for the tubes, a rough screw-thread being also cut in them. A neck is spun on the tubes near their ends, and after being forced home into their sockets, the space between this neck and the screw-threads of the socket is filled by a hard but readily fusible alloy, which is pumped in through holes left for the purpose, and has the property of expanding on solidification. Such joints under static test have proved stronger than the tube itself, and are made with great rapidity. To facilitate the working of the process, an assembling machine is employed, in which the frame is fixed. By tightening up certain screws the tubes are forced home into their sockets, and this done the molten alloy is pumped in, as already explained. With this machine as many as sixty frames can, it is stated, be completed in an ordinary working day. The alloy used melting at a low temperature, there is no danger of the very thin steel tubes, used in light frames, being "burned," and no borax being used as a flux, the tedious after-operation of frame filing is unnecessary. In addition to the static test already mentioned, in which the joint remained intact under a load of 5 tons while the tube broke, practical road trials have also been made in Germany, with the result that the joints have remained perfectly sound and tight after a season's hard riding.—Engineering.

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The Spanish War and the Paris Exhibition.

It would be, it seems to us, very inadvisable for any machine builder who had thought of exhibiting at Paris in 1900 to suspend preparations on account of the feeling that has been generated by the pro-Spanish attitude of French newspapers. Paris newspapers are notoriously infamous and corrupt, and what they say does not by any means necessarily represent the real attitude of the French people toward us, though it is true there is independent evidence to show that there is much ill-will toward us there. Perhaps this is largely on account of a disposition to judge our attitude toward Spain by their own standards, and their inability to see that we could be actuated by any other motive than territorial aggression.

It is probable, however, that this war and much of the feeling growing out of it will be gone and largely forgotten before 1900, and the question of exhibiting or not exhibiting at Paris should be decided upon purely business principles. The machine manufacturer who fails to exhibit at Paris machines which might interest European buyers will hurt himself much more than he will the Frenchmen.

The Paris exhibition is likely to be an important means of further introducing American machinery, and nothing in the form of sentiment—nothing in short but purely commercial considerations should be allowed influence in the matter. Not only France, but all the rest of Europe is likely to be at Paris in 1900, and American machine tool builders especially must also be there.

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The War and Naval Construction.

This war is likely to lead to important modifications of ideas by many people, and especially in regard to our army and its readiness for effective service.

The average American citizen has believed that although our navy might not amount to much and probably could not prevent the landing of a foreign army by a power possessing a strong navy, yet this foreign army once landed would speedily be annihilated by the soldiers which at the word would assemble to form an invincible armada. The length of time that elapsed between Dewey's victory at Manila and the sailing of the first ship carrying soldiers to reinforce him and enable the full fruits of his victory to be gathered gives us some idea of how nearly our preconceived ideas on this point have been correct. It seems to be clearly shown that a well-drilled and thoroughly equipped army such as are maintained by several of the European nations could successfully invade our territory and do much damage before we could be ready to meet it with anything like an effective force.

On the other hand our navy is shown to be the really important branch of our military equipment. As is so well shown by Captain Mahan in a magazine article written previous to the recent naval operations, the idea of a defensive navy must be totally abandoned. He shows clearly that a really defensive navy must be able to go to sea and engage and destroy a hostile fleet wherever it may be found, and that mere floating gun platforms, without speed and manœuvering qualities, would have to be so thick all along our tremendous seacoast line as to make their construction and maintenance cost beyond all comparison greater than would be the case with a real naval fleet capable of striking out from our shores and carrying on offensive operations; in other words doing what our navy is now doing.

Of course the present war is not a defensive one, but it shows clearly enough what we would be obliged to do if we were to engage in a defensive war, and it is also made clear that a war which, so far as its political side is concerned, might be purely defensive would yet necessarily be offensive in its military aspect or be very disastrous to us.

All present signs point to a very decided increase of our naval strength as a result of the present war and we may congratulate ourselves that our naval affairs have been conducted honestly and that money appropriated has produced results. At the end of the present skirmish we shall know about what kind of naval vessels we ought to construct and the probability is that our shipyards will for some time be kept busy constructing them.

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The concise and comprehensive article upon "Patents," the first instalment of which appears in this issue, although longer than we are accustomed to publish, requires no apology for its presentation. It is a compendium of valuable information and suggestion for those who have to do with or who are interested in patents—and who of our readers is not? The remarkable and rare talent of selecting the right thing to say and of saying it in the way most telling, which was so displayed in everything which Chordal ever wrote for these columns is again in full swing in this valuable paper, which we shall publish in three instalments.

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Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(57) J. K. V. P., Rochester, N. Y., asks what distance is required to bring a battleship to rest from full speed, the engines being reversed at full power. *A.*—The only trial of this kind of which we have the data at hand relates to the German armored cruiser Kaizerinn Augusta, of 6,000 tons displacement, 14,500 horsepower, triple screws. From a speed ahead of 18 knots, reversing with full power brought the vessel to a stop in 1½ minutes and in 1,310 feet. From a speed of 11 knots required 55 seconds and 490 feet.

(58) J. F. P., Massillon, Ohio, asks for the composition of an acid mixture for etching steel or iron articles and for instructions for using the same. *A.*—The following composition is recommended for this purpose: Pyroligneous acid 4 ounces, alcohol 1 ounce, nitric acid 1 ounce, by measure. Before applying this fluid to the object to be etched it is important to have the iron or steel clean; after which the surface of the metal on which the etching is to be done should be evenly covered with a thin film of wax, the object of which is to protect that part of the surface not to be etched from the action of the mordant. The lines are then cut through the wax and the fluid poured on. As soon as the metal is sufficiently etched the fluid may be removed.

(59) F. J. H., Silver Cliff, Col., asks (1) for rules for proportioning hoisting drums. *A.*—The text books on machine design do not, we believe, give any atten-

tion to this subject, and knowledge of the proper proportions is confined to those engaged in their manufacture. You will find some information regarding the thickness of the drums and the dimensions of shafts and bearings in our issues of February 11 and March 11, 1897, and February 10, 1898. (2) In large drums are the end spiders cast separate from or in the same piece with the drum proper? *A.*—We think that in large work they are usually made separate. In high grade work the drums are sometimes made with spokes of round wrought iron. These spokes do not, however, drive the drum, but merely carry it, the driving being done from the gear at the end. We hope to publish some drawings of high grade work of this character before long.

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The Mechanical Engineers at Niagara Falls.

As the present issue of the "American Machinist" greets the reader's eye the American Society of Mechanical Engineers is holding its annual movable session at Niagara Falls. There can be little doubt that the meeting will be a large one, and that all who attend will be interested and benefited. There is perhaps no place in the United States or in the world that would seem to offer such inducements for the advanced mechanic or engineer to visit it in these days as Niagara. It is there that the engineer may see in full display what he is most interested in. For a century the engineers of the world have been exercised over the enormous waste of power at Niagara, and now that a fractional percentage of that power is being "utilized" the time of complacency and rejoicing begins at once, and every engineer in the world has a sort of proprietary interest in the show.

It is an anomalous condition that in the display at Niagara there is absolutely no essential novelty. The interesting features are of magnitude alone, whether in the natural phenomenon or in the human devices for directing the natural forces in operation. Power running to waste, as we speak of it, is one of the commonest, most continuous and most ubiquitous in the world. It goes on wherever the winds blow or the rains fall, or wherever fire burns, and the problem of employing the power to our advantage surrounds us completely, and so near and so thick in detail that many opportunities are overlooked. The winds that blow across the roof of one of our tall office buildings all the year round could be made to yield an average of several horse power. Even if all the rains that fall on the roof of the same building in the year could be stored and "utilized" it would give a horse power for one week. In our houses there is wasted power always in the water that we draw from the faucet. In the boiling of an egg in a pint, or pound, of water when it might be done as well in an ounce there is the same waste and the same chance to save. The opportunity at Niagara is in marked contrast to that afforded by these numerous minute sources of power. While they are despised, the problem of Niagara, although essentially the same, is still as great as any that man could wish for. In the successful solution of the problem, in the development and application of power in large quantity and in its transmission to considerable distances, the highest powers of the engineering mind may find employment and the greatest engineers may find satisfaction in accomplishment, and many who are not each the greatest will doubtless find suggestion and stimulus in the sight of what has been or is being done.

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Obituary.

THOMAS CORSCADEN.

It is with profound regret that we notice the death of Mr. Thomas Corscaden, the inventor of the wrought steel pulley noticed in our columns not long since, and superintendent of the American Pulley Company, of Philadelphia, makers of that pulley.

Mr. Corscaden was a New England mechanic who had made a specialty of the working of sheet metal cold, and had developed the manufacture of many hardware articles from that material which have come into wide use. The pulley is the most ambitious of these articles, but the invention of the pulley itself was but a small part of the work involved. The methods of manufacture are highly special, ingenious, and in many particulars unique. The work, moreover, was of a nature requiring a long period of development work—about two years having been spent in getting ready—and it is significant, as an indication of Mr. Corscaden's mechanical ability, that the results were in all particulars substantially as he had given those interested in the enterprise to expect. His estimate of the large cost of the plant required was almost completely verified—the small difference between the estimate and the result being on the right side.

Personally Mr. Corscaden was very unassuming, and no mechanic could long converse with him without forming a high opinion of him. While living in New England he served a term in Congress.

At his death he was in his fifty-fifth year, and he leaves a wife and three children. He died of heart disease.

Robert McKay Morrison, who died in Brooklyn on May 23, spent all his active life in marine engineering. He was born in Portland, Me., in 1843, and was a first assistant engineer and later chief engineer in the United States Navy during the Civil War. After the war he served two years on the battleship Massachusetts. He was later engineer of the Crescent City of the Pacific Mail Steamship Company, and then had an important engineering appointment on the Panama Canal. He was after that successively in the service of the Mallory Line, the Red D Line and the Maine Steamship Company.

Charles J. Goodwin, president and treasurer of the Chapman Valve Company, died at Indian Orchard, Mass., May 27. Mr. Goodwin spent his active life in Indian Orchard, a suburb of Springfield, rising from a bobbin boy in a cotton mill. He was interested in several other manufacturing concerns.

John A. Williams died at Newport News, Va., May 23, forty-two years old. Mr. Wiliams was superintendent of the machine department of the Newport News Shipbuilding & Dry Dock Company, and before occupying that position he was for many years with the Neafie & Levy Shipbuilding Company of Philadelphia. He was a skilled and eminent constructing marine engineer.

William McGurn, Assistant Chief Engineer of the Union Ferry Company, of Brooklyn, N. Y., died on May 10, aged seventy-six years. He had been in the employ of the company since 1851, as engineer on the Fulton ferry; then for twenty-seven years as foreman of the company's machine shop, and later in the position which he held at the time of his death.

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Technical Publications.

NOTES ON HEAT AND STEAM. By C. H Benjamin. 55 6x9 inch pages with 15 illustrations and 9 tables. Second Edition, C. H. Holmes, Cleveland, Ohio. Price $1.25.

This is a condensed manual for students' use, covering the leading principles of heat and steam. It is highly scientific and quite mathematical.

PICTURESQUE UNIVERSITY OF WISCONSIN. Edited by W. H. Hibbs. 32 11x15 inch pages, with numerous illustrations.

This is a folio reprint from a local paper. It is well printed, and shows the university to have a strikingly attractive site and a very complete equipment. A large amount of space is devoted to the engineering departments and shows an outfit which many an Eastern institution might envy.

THE LOCOMOTIVE LINK MOTION. By F. A. Halsey. 81 6x9 inch pages with 46 illustrations. Locomotive Engineering, Price, $1.00.

This book is a reprint of the articles bearing the same title which appeared in our columns last year. In order to make the treatment complete and not require previous knowledge of the plain slide valve, the articles as printed in our columns have been prefixed by a section on the plain valve which, with the aid of the necessary diagrams, explains in detail the action of the valve and the influence of lap, lead and angular advance. This section is taken from the author's older

book, "Slide Valve Gears." The book is thus made a complete treatise, beginning with the elements of the subject, while, as our readers will remember, the articles as published upset some previously accepted views regarding the link, and unsuspected methods of action were demonstrated, the result being probably the first published correct analysis of the link motion. The articles are well worthy of republication in book form, and no one who has to do with link valve motions can consider himself well equipped unless he is familiar with them.

We are in receipt of Part XI. of "Easy Lessons in Mechanical Drawings," by J. G. A. Meyer, which is fully up to the standard set by previous numbers. This number contains the subject of the intersection of surfaces, of which it gives some practical examples. Following this Applied Mechanics is taken up, the section on this subject being devoted to the composition and parallelogram of forces, the treatment being in the characteristic painstaking style of the author. The subject is brought within the comprehension of anyone of mechanical intelligence, and no mechanic can fail to profit by its reading.

THE TRACTION ENGINE: ITS USE AND ABUSE. By James H. Maggard. 128 4½x6 inch pages; cloth, illustrated. Published by David McKay, 1022 Market Street, Philadelphia, Pa. Price, $1.00

This is a book which we think should be in the hands of every man who has charge of a traction or farm engine of any kind. It is written especially for such men by one who has evidently had the required experience. It lets alone those things which properly come within the province of the machinist and is confined strictly to those things which a man who is expected to get work from such engines ought to know and which many of such men learn only by costly or disastrous experience. The author does not pretend that the mere reading of the book will make an engineer out of anyone; in fact he distinctly disavows any such idea, but he gives in plain language the results of experience in learning what to do and what not to do under the various circumstances that present themselves.

MACHINISTS' AND ENGINEERS' POCKET MANUAL. By D. B. Dixon. 375 3x4½ inch pages, with numerous illustrations. Laird & Lee, Chicago.

This is one of those books that are made, not written. It opens with a "dictionary of terms used in steam engineering and electricity." In this we find such choice definitions as "Anemometer—An apparatus to *electrically* record the *direction* of the wind." "Boring Mill—A machine similar to a lathe used for boring." "Cock—A device for opening and closing the aperture in a pipe." "Energy, Joule's —The mechanical equivalent of heat." "Induction, Unipolar—The inability of a body unless influenced by some external force to change its state of rest or motion." "Set screw—A screw that holds two or more parts or pieces together." The electrical part of the dictionary is obviously made up of abbreviated selections from Sloan's Electrical Dictionary. The dictionary occupies 124 pages. Following this comes a hodge podge of electrical matter, tables of English and metric equivalents, decimal equivalents, squares, cubes and roots (38 pages); weight of flat, round and square iron; saturated steam; hyperbolic logarithms, and the inevitable areas and circumferences of circles. Then follows a chapter on mechanical refrigeration, the cuts for which are reproduced from Mr. Penny's articles published by us in 1890, and a miscellaneous lot of questions and answers and promiscuous examples. Screw cutting comes in, of course, and following this are 50 pages of matter on gear teeth, abbreviated from the articles on this topic published in our columns some years ago by Geo. B. Grant, and since republished in book form. The intelligence with which this condensation is made may be judged from the fact that Mr. Grant's engraving of gears of various diametral pitches is here reproduced *on a reduced scale*, in order to get it within the size of the page, although the accompanying text says that the engraving "shows the actual sizes of standard teeth," as indeed the original did, but which the reproduction does not.

The book concludes with 28 pages by Mr. Hobart on the indicator, and five pages by the author on finding the mean effective pressure. We are glad to see something by the author here and there, though the definitions we have quoted above are well calculated to make one feel resigned to a minimum of original work by him. The book is bound in a a nice leather cover.

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One of the wonders of engineering progress has been the slow and gradual revelation of the properties of the link as applied to locomotive engines. It is, to say the least, singular that it should have been reserved to this late day for engineers to find out, as Mr. Halsey in his just issued work on the "Locomotive Link Motion" seems to have done, some important particulars as to the link action, such as, quoting from his preface, "two hitherto unsuspected errors in the motion, and the fact that the effect of the angular vibration of the connecting rod, instead of being a disturbing factor, is in reality a corrective factor." The applicability of the link motion to locomotive conditions is ably and very completely vindicated, but on the basis that the locomotive works under conditions peculiar to itself and so different from the conditions which apply to the stationary or marine engine. This seems to open the way for some explanation of the now wide adoption of the link for the latter service, so different from that of the locomotive.

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The Reeves Pulley Company, of Columbus, Ind., call attention to the fact that although in arranging the variable speed countershaft illustrated in our issue of the 19th ult. to drive a lathe arranged in the ordinary manner the upper cone pulley is placed upon the shaft of the variable speed device, yet it is not considered necessary to use a cone pulley, and where this speed countershaft is originally installed with the lathe the intention is to use a plain pulley only, and to make all changes of speed by the new countershaft only in connection with the usual back gears.

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It is to be noted that in some of the reports of naval operations the monitors are discredited because "being low in the water they are unsteady, and the aim of their guns therefore inaccurate." The fact is, however, that in these statements monitors of about 3,000 tons displacement are compared with other vessels of three to four times their displacement. Monitors are not popular with naval officers, but it is our belief nevertheless that weight for weight they are very efficient fighting machines, and possibly more so than any other.

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It is announced that at Chattanooga, Tenn., on May 21, a consolidation of Southern iron pipe companies was effected under the title of The American Pipe & Foundry Company, with F. C. Hiller, of Anniston, president. The following concerns are included: Howard-Harrison Iron Company, Bessemer, Ala.; Southern Pipe Company, Anniston, Ala.; South Pittsburg Pipe Works, South Pittsburg, Tenn.; Chattanooga Pipe & Foundry Company, and the Bridgeport, Ala., Pipe Works.

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Regarding our notice of the paper entitled "Fatigue of Metal in Wrought Iron and Steel Forgings," by Mr. H. F. J. Porter, we are informed that the Bethlehem Iron Works, South Bethlehem, Pa., make no charge for it, and that they will be glad to send a copy free to anyone asking for it. To anyone interested in wrought iron and steel forgings it is as well worth asking for as anything we know of.

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Some time ago we published an account of a method of making cast gears by baking the mold before removing the iron pattern from it. We have had several inquiries as to the mixture of sand used for such molds, but so far have been un-

able to elicit information regarding it. If any of our readers have succeeded in this or similar work, and will give us the mixture they used, we and our readers will be under obligation to him.

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Mr. Wiener's Method of Finding the Areas of Irregular Diagrams.

BY PROF. I. P. CHURCH.

Being much interested in Mr. Wiener's remarkable and valuable graphic method for obtaining areas of irregular plane figures, as set forth in the issue for May 19, I take the liberty of offering a few criticisms bearing on the mathematical analysis.

Mr. Wiener gives no proof of his method of deriving a second ordinate, z', of the z-curve, after the initial z has been selected (Fig. 6, p. 362), and would seem to imply that it is a strict mathematical necessity that the two arcs of Fig. 6 should "intersect each other in an ordinate midway between z and z'."

It seems to me that the mathematical relations involved at this stage are simply the following: It can easily be proved (and this proof is what Mr. Wiener has apparently omitted) that a right line through F (Fig.6, p. 362) at right angles to $F\ G$ is tangent at F to the z-curve passing through F; and similarly a line through F', perpendicular to $F'\ G'$, is tangent at F' to a z-curve passing through F'. If, now, F is given or assumed, and F' and F are to lie *on the same z-curve* (as desired here; the ordinate through F' being taken so near to F that the portion of the z-curve between them may be assumed to be fairly smooth and of slight curvature), we can determine the point F', on the assumed vertical F', approximately, by drawing the above-mentioned tangent line through F, and then, by trial with the 90 degree corner of a right-angled triangle, finding such a point F', on the vertical F', that its tangent line (as above, perpendicular to $F'\ G'$) shall intersect F's tangent in a point approximately equidistant from the *points* F and F'. If the segment of the z-curve between F and F' were the arc of a circle, this intersection would be *exactly* equidistant from the points F and F'; whereas, if the segment of the z-curve were a portion of a parabola having a vertical axis, the intersection would lie on a vertical line midway between the *verticals* F and F'; and, again, if the segment were a portion of a parabola having a horizontal axis, the intersection would occur on a horizontal line situated midway between the horizontal lines passing through F and F'.

The short arcs employed by Mr. Wiener are used by him, doubtless, as convenient approximations to the tangent lines above mentioned, but since the z-curve involved is just as much an irregular curve as the boundary of the original plane figure, it seems hardly justifiable to claim, or imply, that the intersection of the two arcs in Fig. 6 must of necessity lie on an ordinate midway between z and z', or to speak of a deviation from this relation as involving an error (see the quotations from Mr. Wiener in the editorial note, p. 365).

Of course, Mr. Wiener's method does not claim strict accuracy in its results, but it would seem important that in giving its mathematical demonstration no essential step shold be omitted and that a careful distinction be made between those relations which are strictly exact and those which, from the nature of the case, can be only approximate.

Cornell University.

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Pickling Castings.

Editor American Machinist:

I have to confess to a little surprise at Mr. Oberlin Smith's letter in your issue of May 19, in which he asks as to the advisability of pickling castings, and then also at his suggestion that the disadvantage of the process lies chiefly in the expense. From the machine shop workman's standpoint I know very decidedly the difference between castings which have been pickled and those which have not. The proprietor or superintendent also should appreciate the difference in the wear of tools, with the time required for resharpening and resetting, and the more rapid wearing out and more frequent renewal of them, if used upon sand and scale, as compared with their use upon castings which have been thoroughly pickled. With a just appreciation of the tool saving and the time saving effected by pickling the cost of the process cuts a small figure.

As to the use of the pickling process for castings of considerable weight I have my doubts, but principally because my experience has never had to do with pieces above, say, 200 pounds. Up to that weight and down to the smallest castings I think they should be pickled if much machine work is to be done on them.

I have known two somewhat different processes employed for pickling castings. In the first way a lead lined wooden tank is provided of a size and shape determined entirely by the size, shape and quantity of castings to be handled. With a tank 6 feet by 3 feet and 2 feet deep a large quantity of castings may be pickled. The tank should preferably be sunk a foot or so in the ground. From one of the long sides there should extend back a long, tight wooden platform, say 6 feet wide and 12 feet long, with raised strips on the edges and a pitch of two to three inches to the foot toward the tank. The pickle in the tank should be one part vitriol to four parts water. A very common mistake is to think that more vitriol will hurry matters, or do the work more thoroughly. The reverse is the case, so an excess of vitriol is to be avoided. The water is of course put in first and the vitriol added gradually, as the addition of the vitriol heats the water. It will be well to fill the tank to within 6 inches or 4 inches of the top.

The articles to be pickled, if of convenient size to handle, are simply dipped in the pickle, so that they are wet all over and then laid on the platform to drain and dry. If the castings are too large or too heavy for dipping they are laid on the platform and the pickle is poured over them with a dipper. They should be turned as much as necessary to wet them all over, and none of the castings should be left so that the pickle has a chance to settle in pockets or places that will not drain. The castings are then left for eight to twelve hours, when they will be covered with a white powdery substance. It is only necessary to dip the castings in boiling hot water, or to pour the hot water over them, until they are thoroughly cleaned of the acid, and when they are dry the process is completed. A hot water tank is of course provided, with a steam pipe for heating the water. This water should be renewed frequently or the acid will not be thoroughly removed. An additional refinement is to provide a hot potash or soda bath before the final rinsing in clean water. If by this process the first pickling does not sufficiently remove the sand and scale it may of course be repeated.

In the second process tanks are provided of sufficient capacity to submerge the castings for several hours. Sometimes they may remain in the pickle over night, and when taken out they may at once be rinsed in an adjoining tank of clear water, or, what is better, in two tanks in succession. The pickle for this slow pickling should be much weaker than for the first process, the vitriol not being more than one-tenth that of the water. I am inclined to decidedly prefer the first way of dong it.

This being the entire process it is evidently not an expensive one. I am unable to give any figures as to the waste of vitriol, but it lasts quite a long time. The only other expense is the labor. It is evident that one man can handle a large quantity of castings. In my opinion no establishment that has used thoroughly pickled castings will be likely ever after to be satisfied without the pickling. Tumbling is not a substitute for pickling, as it does little toward removing the scale. Tumbling before pickling is good and saves the pickle. Pickling without tumbling is better than tumbling without pickling, so far as the wear of tools is concerned. There is of course a place where it is desirable, and beyond that a place where it is imperative, to draw the line as to pickling. All castings do not

require pickling, and many castings it will not pay to pickle, but it will not pay to abandon pickling for a manufacturing machine shop of any magnitude.

MORRIS FULTON.

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Personal.

Mr. Boyer, of the Boyer Machine Company, St. Louis, returned on the 23d ult. from a three months' trip to Europe.

H. W. Johnson has resigned his position with the Mt. Carmel (Pa.) Iron Works to accept the management of the Pratt & Whitney Company's foundry at Hartford, Conn.

Comander A. D. Brown, of the United States Navy, who was placed on the retired list several years ago on account of ill health and has recently been president of Norwich University, has been ordered to Charlestown (Mass.) Navy Yard as equipment and ordnance officer.

Mr. John Blencome, formerly with the Walker Manufacturing Company, of Cleveland, Ohio, and for the past five years superintendent of the Pennsylvania Boiler Works, Erie, Penn., has resigned and has taken charge of the air compressor department of the Ingersoll-Sergeant Drill Company, Easton, Pa.

R. S. Paul has been appointed chief engineer, U. S. N., and ordered to the Dixie.

The following have been appointed to the rank of passed assistant engineer, U. S. N.: F. J. McMahon, Washington, D. C.; William D. Weaver, Havemeyer Building, New York; H. S. Pugsley, 848 Hancock street, Brooklyn; W. C. Bennett, Elizabeth, N. J.; David Ritchie, 506 West Twentieth street, New York; J. H. Mittendorff; Charles A. Deigh, Boston, Mass.; John L. MacVicar, Lowell, Mass.

The following have been appointed assistant engineers in the U. S. Navy: R. P. Browne, R. C. Wilson, W. A. Furlong, W. T. Clarke, Chicago, Ill.; T. W. Clark, Cambridge, Mass.; J. I. Wile, Rochester, N. Y.; James Quilty, 15 Leroy street, New York; George B. Massey, Watertown, N. Y.; Wyman G. Hawthorne, 1480 Madison avenue, New York; Howell C. Cooper, Oil City, Pa.; Harry E. Middleton, Washington, D. C.

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Mr. C. N. Powers, superintendent of the Consolidated and McKay Lasting Machine Company, Beverly, Mass., has returned from a two months' stay at Sunapee Lake, N. H.

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The Atlas Tack Company, of Taunton, Mass., have a widely scattered plant, and have adopted electric power distribution as being better adapted to these conditions than steam and shafting. Three mills will be driven from a central station, the radius of action being about 1,500 feet. Two steam plants and several long lines of shafting will be dispensed with. When the installation is complete it will comprise between thirty and forty motors, which, together with the generators, are of the Westinghouse make.

Commercial Review.

NEW YORK, Saturday Evening, May 26, 1898.

DYNAMOS AND MOTORS.

The market has not been of an active character this month. All of the several lines, lighting, factory power and railway work, have been more or less retarded. Large enterprises are held back, owing to lack of confidence, and there is not the local demand for motors for installation in small manufacturing establishments that there should be. At the same time it is apparent that in some quarters business has recovered somewhat from its lowest ebb.

Both the General Electric and Westinghouse companies are among the busy ones, which, in regard to the former, may be inferred from the fact that it has had to turn down a $7,000 order because it could not assign a date for delivery of the apparatus. On another contract for a type of machinery for which the works have a large capacity the best terms it could make were three months' delivery, with an uncertainty of having the order executed even at the end of that time. After an investigation of prevailing conditions in electrical machinery the purchaser decided to accept the offer upon those terms.

We are informed by certain parties that prices have lately shown a tendency lower if anything than hitherto. Upon inquiry to ascertain whether this state of affairs is generally prevalent, certain other authorities state, to the contrary, that values are becoming stiffer. It is to be inferred, therefore, that no concerted change is occurring in the market, although concessions may be made by some people who have stock they wish to dispose of. In fact, prices for electrical machinery do not usually move up or down in the same perceptible manner as those on pig iron or steel billets.

There has been some rush demand for electrical apparatus for installation in steel works that are busy on Government contracts. There is also a little demand, both at home and abroad, for electrical hoists.

That dullness in the electrical field is not very intense may be inferred from the fact that more than one concern is reported to be filled with orders enough to keep it busy for three months, and not impossibly this may be true of a good many more.

We subjoin mention of a few of the more interesting contracts or installations lately made by various companies:

The Bullock Electric Company has lately equipped the New York "Journal" and "World" each with an 80 horse-power motor to drive a color printing press by the Teaser system. It is stated that these are the largest color printing presses in the world.

The Fort Wayne Electric Corporation has closed a contract to furnish a municipal electric lighting plant to the town of Lehighton, Pa. It is said that both arc and incandescent lights will be included in the system.

In the street railway line it may be worthy of note that the New York, Elmsford & White Plains Railway Company is being furnished by the General Electric Company with 15 car equipments and a 500 kilowatt generator. The General Electric Company has sold the Newark (N. J.) Traction Company 40 large motor equipments.

There has already been mentioned in these columns the letting of contracts for part of the machinery to be installed on the Manaos Street Railway, Manaos, State of Amazonas, Brazil, which is controlled by New York capitalists, and for which Edgar C. Moxham & Co. are the contractors. It may be added that the Walker Company has been asked to supply three 130 kilowatt dynamos. The Steel Motor Company is to furnish motor equipments.

Among other sales by the Walker Company may be mentioned generators of from 200 to 250 kilowatts capacity to the Holland and Lake Michigan Railway Company, the Norton and Taunton (Mass.) Street Railway Company, the Wheeling and Elm Grove Electric Railway Company (two machines), and the Lewiston (Idaho) Electric Light Company.

The Midvale Steel Company, which does considerable Government work, recently sent a rush order to the C & C Electric Company for two 50 horse power motors. The Pencoyd Iron Works are adding more Crocker-Wheeler motors to their present electrical equipment, and no doubt Government work has occasioned it.

In the Government buying that has taken place in connection with the present war, Crocker-Wheeler rotary transformers have been in requisition. A dynamo of that make, accompanied by an engine, has lately been shipped to a South American country for installation in a native troopship.

One factory enterprise that is going ahead in spite of the war is an electrical power transmission installation in the works of the Old Colony Rubber Company, Cambridge, Mass. A 120 kilowatt generator and a 150 horse-power motor have been ordered from the C & C Electric Company.

In the Vincent Building, Broadway and Duane street, New York, three dynamos are to be installed. The bids are in, but the award of the contract is not yet announced.

It is stated that there are in the market estimates for two complete electric light and power plants for Brazil, and quotations are being asked on two electric lighting plants for Japan.

If a newspaper report is to be credited, the Siemens & Halske Company, of Berlin, Chicago and New York, contracted

with the authorities of Moscow, Russia, to construct six lines of electrical railways in that city and to take charge of the present lighting system. According to the same authority a concern known at the Chilian Electric Tramway & Electric Light Company has been organized in London with a capital stock of $5,250,000, and with the purpose of working and maintaining electric railways, light and power plants, etc., in Chili. It is conjectured that American manufacturers may be able to obtain contracts to furnish apparatus.

A steam engine concern represented in this market is quoting on two large engines for electric lighting purposes for shipment to Australia.

NEW ENGLAND NOTES.

Beaman & Smith, of Providence, R. I., are preparing to build new shops on land they have acquired for the purpose, and will have all modern appliances for their work. Power will be supplied in the form of an electric current from the plant of the Narrangansett Company. Beaman & Smith report good business, and they are sending many heavy machines abroad.

The Brown & Sharpe Manufacturing Company, of Providence, R. I., is now employing 1,500 men, which is more than at any previous time.

It is reported that a contract has come through a local banking house to a tool manufactory in New Haven for $18,000 worth of machinery to be shipped to Hamburg and probably thence to Russia.

CHICAGO MACHINERY MARKET.

A peculiarity in the machinery market this week was the placing of an order for a milling machine for September delivery. The almost uniform rule has been for the buyer to want the machine or tool at the time he orders it and to be restive under even a few days' delay. Consequently the extreme providence of a manufacturer in projecting shipping instructions four months into the future is an occurrence so rare as to excite comment. Another item of passing moment has been the deliberate choice by a small buyer of the more expensive, though preferable, machinery. Price has usually been a consideration of superior importance. There are evidences, therefore, of educational forces at work, slight as they may be, and possibly only transitory.

Reports are in full accord that the past week has been quiet in iron machinery. Fluctuations as they appear from week to week are often so erratic as to defy explanation, though the trend of trade, on the whole, follows the direction taken by general commerce. At present the harmony appears to exist, though a slow and gradual revival of pig iron and of rolling mill product is discernible.

Activity has recently appeared in the fitting out of small bicycle repair shops throughout the West. The increasing use of the wheels accompanying reductions in price has occasioned the multiplicity of these scattered repair shops, and, while the equipment of each has been slight, the aggregate has been an important factor in the current tool trade. The large bicycle factories are approaching the end of their season and are confining purchases to small tools. Present indications are that they will soon shut down and that they will start up for the new season about August. In this connection it may be stated that the large agricultural implement works give promise of running all summer. They certainly will unless there is unfavorable change in crop or financial conditions. The custom has been in recent years to suspend operations for several months during sum-

Continued on page 42.

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Business Specials.

Gear wheels, gear cutting. Grant; see page 20.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Conn.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Persons ambitious to understand all about link motion should send $1 to Loco. Engineering, 256 B'way, New York, for Halsey's Locomotive Link Motion.

Cutters, reamers and small tools, regular and special; vertical millers, cutter and surface grinders, shears and punches. R. M. Clough, Tolland, Conn.

Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted.

Mech. draftsman, 8 years exp. Box 75, AM. MACH.

Mech. draftsman, G. W., care of A. Haas, 108 Av. A., N. Y.

Detail draftsman wants change; accustomed to light bench machinery; good ref. Box 65, AM. MACHINIST.

Young man wishes to learn machinist's trade; marine engine or locomotive shop preferred. Address M. R. C., 79 Rutger street, Utica, N. Y.

A position as foreman of foundry; can do all kinds of work; green sand, dry sand or loam work; the best of reference. Box 71, AMERICAN MACHINIST.

First-class practical and technical mechanical engineer wants pos. as superintendent of machine shop; best references. Address Box 77, AMERICAN MACHINIST.

Mech. draftsman would like to change; quick in designing auto. and special machine tools, jigs, fixtures, etc.; age 21; speaks German. Box 72, AM. MACH.

Brass foundry foreman wishes position; mixes all classes of metals; first class at all details of shop work, light or heavy castings, core work, &c. Box 60, AMERICAN MACHINIST.

Foreman pattern maker, running from ten to thirty men on engine and machine work, wishes to make change; 15 years' experience; three years as foreman. Box 68, AMERICAN MACHINIST.

Wanted—Position of responsibility by a first-class machinist and draftsman; have held positions as general foreman and can furnish best of references Box 49, AMERICAN MACHINIST.

An absolutely first-class tool maker, 33 years; experience on gun, typewriter, bicycle and other tools of like character, desires position as head tool maker or foreman. Address Box 73, AMERICAN MACHINIST.

Practical draftsman, 6 years' experience designing, erecting, running, reforming heavy sugar machinery, wishes position erecting or draftsman; no high salary expected. Address Box 74, AMERICAN MACHINIST.

Help Wanted.

Draftsman wanted—One well acquainted with mod. stat. and marine engines. Apply Box 22, AM. MACH.

Wanted—Good all round machinists for general jobbing and repair work; state age, experience and wages wanted. Beall Machine Works, Cumberland, Md.

Wanted—Mech. as head foreman of mach. and exp'l shop (70 men), familiar with economical manufacture of mechl. and electr'l instruments; only man of energy and ability, having held similar position, need apply; state ref., exp., age and sal. exp'd. Box 76, AM. MACH.

Wanted—Foreman for machine shop employing fifty hands, on Corliss, high-speed and marine engines; first-class man of experience only need apply. Box 23, AMERICAN MACHINIST.

Wanted—First-class machinist who understands handling automatic button machinery and can make his own tools; permanent position at good wages; references required. Box 78, AMERICAN MACHINIST.

Wanted—First-class draftsman, experienced in locomotive designing. Write stating exp., age, sal. exp't'd and date could take position to Head Draftsman, 506 Washington Life Building, 141 B'way, New York city.

Draftsman Wanted—A large establishment building ice and refrigerating machinery and stationary engines wishes to employ a first-class draftsman; one thoroughly familiar with the lines named. Write at once to Box 70, AMERICAN MACHINIST.

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Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Shop agents wanted for book on Dies and Die Making.

Book, Dies & Die Making, $1. J. L. Lucas, Prov., R. I.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes and planers. Dietz, Schumacher & Boye, Cincinnati, O.

Advertising Novelties Wanted—We will buy patents, manufacture for patentee or on a royalty, good advertising novelties Address P. O. Box 125, Erie, Pa.

Wanted—Good house to act as sole sales agency of a new agricultural machine; something practical and new; best of prospects. Address Box 69, AM. MACH.

The advertising department of the American Machinist has on hand 30,000 drafsman's thumb tacks; will send a box of ten to any draftsman in America on request; could use a postage stamp on box, but will send the tacks anyway.

Institutions retiring from business having machine tools, brass or wood working machinery, will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach Co., 55-59 Woodbridge st., W., Detroit, Mich.

Wanted—Partner with $7,500 to invest in a snug, profitable and exclusive bus., already est. and fully protected by patents; with proper facilities can do a splendid business; for the right man it's the chance of a lifetime. Address Capital, P. O. Box 316, Bridgeport, Ct.

CASH BUYERS LIKE OUR PRICES.

This screw plate is for threading a variety of necessary work. Comprises five taps, five dies and die holder in neat wooden case.

Retail Price $4.25.

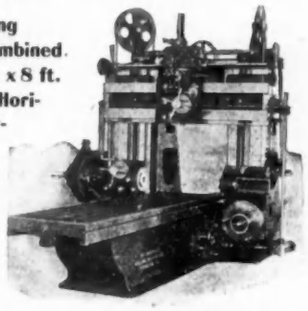
Mailed on receipt of $3.25, or at our store, $3.00.

An illustrated catalogue of 1,500 other bargains mailed for only 14 cents, U. S. stamps or silver.

THE FRASSE COMPANY,
17 Warren St., NEW YORK.

26,000 lbs.

Net shipping weight. Combined. 36 x 36 in. x 8 ft. machine. Horizontal, vertical or combined machines. Sizes 15 in. up.



THE INGERSOLL MILLING MACHINE CO.,
Box 2777. **Rockford, Ill., U. S. A.**

mer. Last year orders were so heavy that the idleness was for only a few days' duration—long enough for inventory. This year similar conditions exist.

The Illinois Steel Company is now booking more orders than it can produce. The effect has been to strengthen prices slightly. The company consumes so much of its Bessemer pig iron product that a smaller furnace capacity than usual can be devoted to the general outside pig iron trade. The consequence has been that Southern pig iron has lately enjoyed a phenomenal success in this market.

Dullness has apparently not affected belting. The Chicago Belting Company, 71 South Canal street, reports that, while its trade at this season is usually confined chiefly to small sizes, it this year is receiving a large number of orders for main belts, 30 to 60 inches.

Charles H. Besly & Co., 10 North Canal street, are enjoying a continued trade of satisfactory proportions. Exports during the past week included shipments of Gardner grinders to Scotland and to South America.

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Quotations.

NEW YORK, Saturday, May 28.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$11 00 @ 11 50
No. 2 foundry, Northern	10 50 @ 11 00
No. 2 plain, Northern	10 00 @ 10 50
Gray forge, Northern	10 00 @ 10 50
No. 1 foundry, Southern	10 75 @ 11 00
No. 2 foundry, Southern	10 25 @ 10 50
No. 3 foundry, Southern	10 00 @ 10 25
No. 1 soft, Southern	10 75 @ 11 00
No. 2 soft, Southern	10 25 @ 10 50
Foundry forge, Southern	9 75 @ 10 00

Bar Iron—Base—Mill price, in carloads, on dock: Common, 1.05 @ 1.10c.; refined, 1.10 @ 1.20c. Store prices: Common, 1.25 @ 1.35c.; refined, 1.30 @ 1.50c.

Tool Steel—Base Sizes—Standard quality, 6 @ 7c., with some grades perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—Ordinary brands, from store, in small lots, 1.45 @ 1.50c.

Cold Rolled Steel Shafting—Base sizes, from store, 2.15 @ 2.20c., according to quantity.

Copper—Carload lots: Lake Superior ingot, 12c.; electrolytic, 11¾ @ 11⅞c.; casting copper, 11½ @ 11¾c.

Pig Lead—Carload lots, 3.75 @ 3.80c., f. o. b., New York.

Pig Tin—For 5 and 10 ton lots, 14.95 @ 15c., f. o. b.

Spelter—Carload lots, 4.30 @ 4.35c., New York delivery.

Antimony—Hallett's, 8¾ @ 9c.; Cookson's, 9¼ @ 9½c.

Lard Oil—Prime city, present make, 54 @ 56c., according to brand.

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Manufacturers.

Brown's machine shop at Winsted, Conn., is to be rebuilt.

The Harter mill at Fostoria, Ohio, is rapidly nearing completion.

The foundation is going in for the addition to the Columbia Mill, Lewiston, Me.

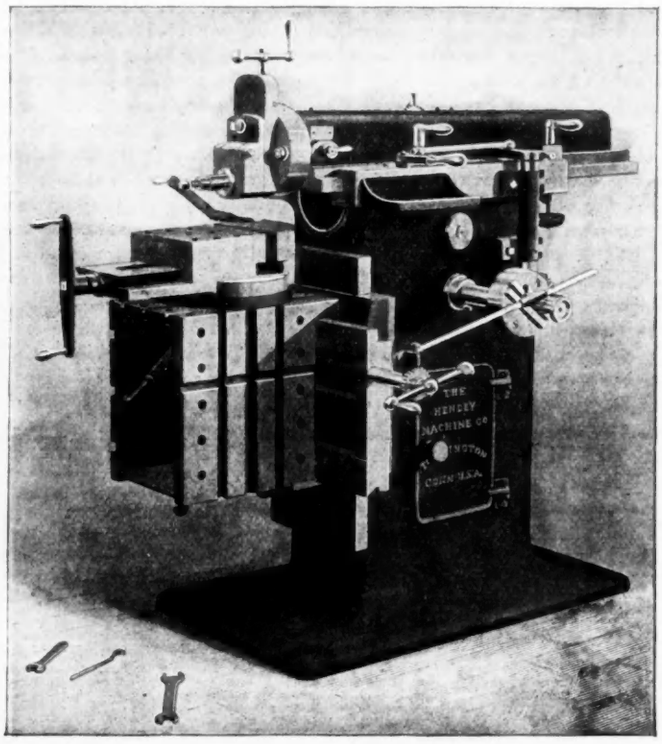
At Le Roy, N. Y., Messrs. McEwen & Cole are to erect another flouring mill.

The Mitchell Electric Light Plant, Mitchell, S. Dak., was recently destroyed by fire.

The Frontier Brick Works Company, of Niagara Falls, N. Y., has been incorporated.

The Victoria Mills, of Rock Hill, S. C., will, it is said, place new machinery at an early date.

At a recent meeting of the officers of the Schoen Pressed Steel Company, of Allegheny, Pa., it was decided to increase the plant at a cost of about $250,000. A steel building will be erected to house machinery sufficient to in-



24 inch

Pillar Shaper.

These shapers have a positive locking friction, and are guaranteed to work accurately to a line.

Stroke quickly adjusted to any position with ram in motion. Then it can be varied in the smallest degree with our micrometer adjustment stop. Shapers have quick return, also two cutting speeds.

The

Hendey Machine Company,

TORRINGTON, CONN.

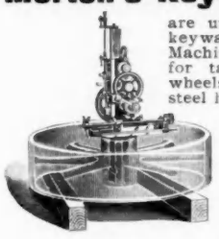
Agents for the Pacific Coast: Pacific Tool and Supply Company, San Francisco, Cal.
J. W. Cregar, Philadelphia Bourse Exhibition,

EUROPEAN AGENTS:
Schuchardt & Schutte, Berlin, Vienna, Brussels, Stockholm; Chas. Churchill & Co., Ltd., London and Birmingham, England; Adolphe Janssens, Paris, France.

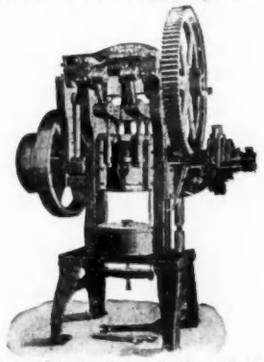
MACHINE DESIGN,
Mechanical Drawing, Mechanical, Electrical and Steam Engineering,
TAUGHT AT YOUR HOME FOR $2 PER MONTH.
This pays for Text Books, Drawing Plates and Instruction until you complete the course. Write for free Circular T.
THE UNITED CORRESPONDENCE SCHOOLS,
F.W. Ewald, G. Mgr. 154-158 Fifth Ave., New York.

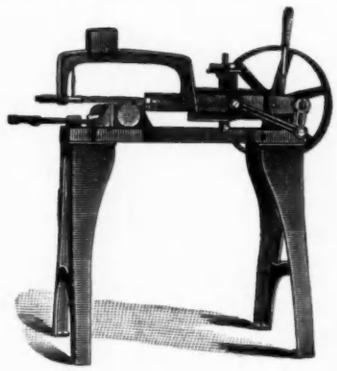
The **CROSS OIL FILTER**

actually reduces oil bills 50% or more. Sent on approval. Capacities 3 to 120 gals. per day. Used in 18 countries. Testimonials from the leading firms in every field of industry.
THE BURT MFG. CO.
AKRON, OHIO, U. S. A.
Business Established 8 Years.
Largest Manufacturers of Oil Filters in the World.

Morton's Keyway Cutters

are unequaled for cutting keyways in heavy work. Machines especially adapted for taper bored propeller wheels. Keyways cut in steel hubs 28 in. long, 2½ in. wide, 1¼ in. deep; time, 35 minutes.
Morton Mfg. Co.,
Muskegon Heights, Mich. U. S. A.
Builders of a complete line of Keyway Cutters, Iron Shapers and Portable Planers.
Eastern Branch: 126 Liberty Street, New York, N. Y.; Walter H. Foster, Manager.
Glasgow Office: 40 St. Enoch Square; James Ritchie, Manager.
Schuchardt & Schutte, Berlin, Vienna, Brussels.
Adphe. Janssens, Paris, France.

TOOLS
Our new Catalogue of Fine Mechanical Tools, Milling, Gear and other Cutters, 112 pages, will be sent free to anyone who asks for it.
THE L. S. STARRETT CO.,
Box 59, Athol, Mass., U. S. A.

E. W. BLISS CO.
1 Adams St., Brooklyn, N. Y.

No. 1 1-2 Bliss Toggle Drawing Press (Pat'd).
PRESSES, DIES, DROP HAMMERS and SPECIAL MACHINERY.
CHICAGO OFFICE; 96 W. WASHINGTON ST.
EUROPEAN OFFICE:
39 Rue Caumartin, Paris, France—A. Wilzin, Mgr.
Owners of the Stiles & Parker Press Co.
Manufacturers of the WALDRON FRICTION CLUTCHES.

"The best is as good as any."
The New
Automatic and Gravity Feed
Q & C Shop Saw

Cuts { Tool Steel, Machinery Steel, Iron, Brass and All Other Metals.
Price—'Way Down.
Quality—'Way Up.
Shop Saws,
Portable Rail Saws,
Cold Power Saws,
For All Purposes.

Send for Catalogue.
Q & C Company,
Chicago. New York.
LONDON: Chas. Churchill & Co.
PARIS: Hounsfield & Fils.
BERLIN: Schuchardt & Schutte.
MADRID: J. G. Neville & Co.

crease the output of the works fifty cars per day.

It is understood that the Embreville Iron Company is soon to rebuild its furnace at Embreville, Tenn.

The C. W. Hunt Company, of West New Brighton, S. I., has recently added a brass foundry to its plant.

The paper mill building of John T. Moore & Son, Bellows Falls, Vt., is being entirely rebuilt and another story added.

The town of Watervliet, N. Y., is contemplating the installation of a new engine and boiler for electric lighting purposes.

Amos Abbot & Co., of Dexter, Me., is to enlarge their plant by the construction of a mill 300x60 feet and three stories high.

Articles of association of the Hio Furnace Company, of Jackson, Mich., have been filed. The capital stock is placed at $10,000.

At Detroit, Mich., the Michigan Safety Furnace Pipe Company has been incorporated by Isaac, Samuel and William Stearns.

The Stanwix Engineering Company, of Rome, N. Y., is to make the plans for the electric light plant to be built at Charlotte, N. Y.

Hotchkiss Brothers have received the contract to build the addition to the Excelsior Needle Company's factory, Torrington, Conn.

The Malleable Iron Manufacturing Company, of Duluth, Minn., is considering the matter of engaging in the manufacture of car couplers.

The reduction plant and laboratory of the Canadian Goldfield Company, Limited, at Deloro, Ont., has been burned. Loss, about $60,000.

Lansing, Mich., is to have a sawmill with an annual capacity of 60,000,000 feet of lumber. It will be erected by a Mr. Brown, of Fowlerville, Mich.

The Evanston Brick Company, of Cincinnati, Ohio, has been incorporated by Robt. Murdock, Frank H. Reid, Thos. D. Corry and Frank B. Wylie.

The Carpenter Steel Company, of Reading, Pa., recently received a contract to furnish projectiles for the Government amounting to $450,000.

M. D. Wayman, of New Kensington, Pa., is organizing a company to manufacture bricks by a new process. The company will be capitalized at $50,000.

The Metropolitan Street Railway Company, of this city, is to erect a four story power house. It is announced the building will cost about $350,000.

The T & B Tool Company, of Danbury, Conn., has ordered machinery to double the capacity of its plant, which is now working about twenty-two hours per day, but is still not able to keep ahead of orders.

A gasoline tank in the American Steel Foundry, St. Louis, Mo., blew up recently. The explosion caused a fire, which burned down the smelter and part of the molding department. The loss is estimated at $75,000.

The Troy Laundry Machinery Company, Chicago, Ill., has purchased a tract of vacant land at South Chicago, near Houston avenue and Ninety-fifth street, and will construct a plant at that place for the manufacture of laundry machinery.

The Challenge Machine Company, of Philadelphia, Pa., recently shipped to the Charlestown Navy Yard an outfit consisting of seven grinding and polishing machines, a duplicate of an outfit supplied to the League Island Navy Yard some months ago.

The Fries Manufacturing Company, of Salem, N. C., manufacturers of fertilizers, have adopted electric power for their fertilizer mills, and have installed the Westinghouse induction motor. The plant also includes a city pumping station, a planing mill, machine shop and foundry. The plant is to be operated by unskilled labor so far as electric knowledge is concerned.

The new building which the Waterville Cutlery Company are erecting at Waterville, Conn., will have a steel roof, which is being erected by the Berlin Iron Bridge Company. The building is 21 feet wide and about 100 feet long, and is to be used as a forge shop in one

end and in the other will be located the boilers and engines.

The Born Steel Range Company will erect a factory on its property on Pearl street, Brooklyn.

The Helfrich Saw Mill Company, Evansville, Ind., will soon build a large new dimension mill in connection with their saw mill near the cotton mills.

The Reynolds & Reynolds Company will build a new factory on the ground lately occupied by the Staniland Company, on Washington street, Dayton, Ohio.

The contract for the erection of C. Turnbull & Co.'s new factory on Water street, Galt, Ont., has been given to Mr. W. A. Kribs, M. L. A., of Hespeler.

J. E. Lafferty is preparing plans for the erection of an addition to the iron foundry of S. B. Sexton & Son, Conway, near Greene street, Baltimore, Md.

The Thomson Chemical Company, of Baltimore, Md., has been incorporated by P. H. Hoffman, Joel C. Dunbracco, E. M. Hoffman and John G. Westcott.

The Urie-Brewster Manufacturing Company, of Kansas City, Mo., recently filed articles of incorporation. W. J. Brewster, M. S. Brewster and J. C. Urie are the principal stockholders.

It is quite probable that a company will be organized and a factory erected at Tecumseh, Mich., to engage in the manufacture of car couplers. L. P. Tribon and F. B. Wood are interested.

The Cooley & Trevor Manufacturing Company, of New Britain, Conn., has filed a certificate of organization. The company is organized to manufacture and sell machines. The stockholders are Henry B. Cooley, of Hartford; James E. Trevor, of Hartford, and Joseph Hirth, of Hartford.

Architect A. H. Beers is remodeling the plans for the new factory for Curtis & Curtis, Bridgeport, Conn. It will be 50x85 feet, of brick, three stories high, of heavy mill construction, with a flat roof covered with gravel.

A new company, known as the Catasaqua Iron Company, with a capital stock of $50,000, has been formed. The offices of the concern are in the Girard Building, Philadelphia, Pa. W. S. Pilling, T. I. Crane and J. L. Mitchell, of Philadelphia, are interested.

Recently at Arlington, N. J., there was organized the Pycott Manufacturing Company. The capital of the new concern is $1,000,000. The company has secured control of the Hamlet Mills, Woonsocket, to which a large addition will be built, and the Standard Oil Flask Company, of Taunton.

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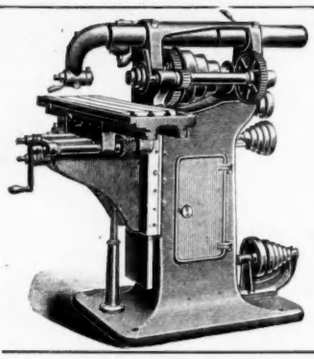
New Catalogs.

There are three sizes of Standard Catalogs, first authorized by the Master Car Builders' Association, 9" x 12", 6" x 9" and 3½" x 6". We recommend the 6" x 9" size for machinery catalogs. When they must be larger or smaller, one of the other standard sizes should be adopted if possible.

Fay & Scott, of Dexter, Me., have sent us special catalog of pattern makers' lathes. Illustrations of these lathes are given, together with prices. The catalog is standard size, 6x9 inches, and a copy will be sent to all interested upon application.

The White Manufacturing Company, of Chicago, Ill., has issued its 1898 catalog of gasolene and kerosene appliances for bicycle manufacturers and repairers, plumbers, braziers, etc., consisting of braziers, forges, enameling ovens, etc. The catalog is standard size, 6x9 inches.

The Tight Joint Company, of New York, has sent us catalog of high pressure air and hydraulic fittings and flanges. The catalog contains a great amount of information of value to those having to do with hydraulic engineering; also tables of areas of circles, strength of pipes, etc. The catalog is 4¾x6¾ inches.



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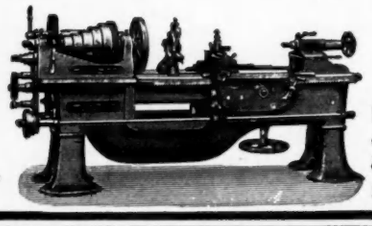

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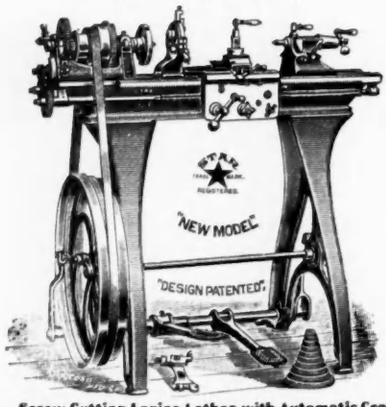

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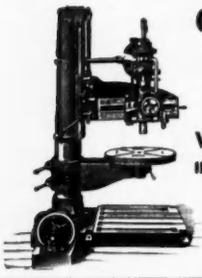

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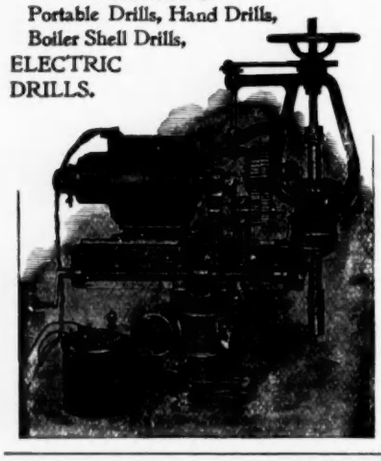

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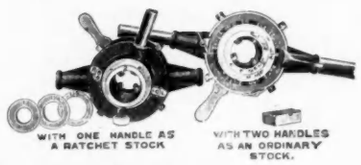

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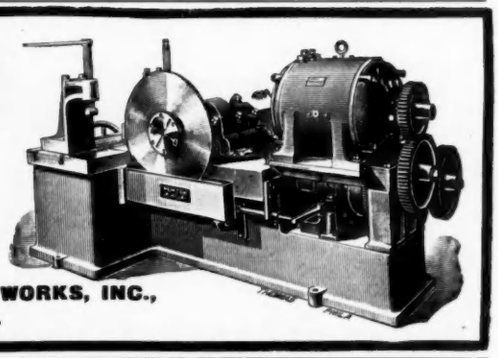

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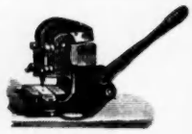

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1 50 x 20 Fifield Lathe.

PLANERS.

1 17 x 17 x 4 Putnam Planer.
1 24 x 24 x 6 Davis & Egan Planer, good order.
1 26 x 26 x 6 Davis & Egan Planer, good order.
1 30 x 30 x 8 Pease Planer, good order.
1 30 x 30 x 8 Powell Planer, good order.
1 30 x 30 x 8 New Haven Planer.
1 30 x 30 x 12 Davis & Egan Planer, good order.
1 36 x 36 x 12 Smith-Silk Planer, two heads, good as new.
1 36 x 36 x 12 Pease Planer.
1 42 x 42 x 16 Pond Planer, two heads, good as new.
1 48 x 48 x 16 Sellers Planer.

DRILLS.

1 22½ in. B. G., P. F. Drill, good as new.
1 25 in. Standard Drill, B. G., P. F., good as new.
1 28 in. Drill, B. G., P. F., National.
1 32 in. Drill, B. G., P. F., National.
1 72 in. Comb radial drill, good order.
1 4 ft. Plain Radial Drill.
1 5 ft. Plain Radial Drill, good order.
1 5 ft. Niles Half Universal Radial Drill.

SHAPERS.

1 12 in. Smith & Mills Shaper, good as new.
1 15 in. Steptoe Shaper.
1 15 in. Betts Traveling Head Shaper.
1 15 in. Davis & Egan Shaper, good as new.
1 17 in. Davis & Egan Shaper, good as new.
1 26 in. Davis & Egan Shaper, good as new.

MILLING MACHINES.

1 No. 0 Davis & Egan Plain Milling Machine, good as new.
1 No. 2 Davis & Egan Plain Milling Machine, good as new.
1 No. 3 Davis & Egan Plain Milling Machine, good as new.
1 No. 2 Davis & Egan Universal Milling Machine, good as new.

SCREW MACHINES.

1 ⅞ in. Screw Machine, good as new.
1 1¼ in. Screw Machine, good as new.
1 1¾ in. Screw Machine, good as new.
1 2⅛ in. Screw Machine, good as new.

MISCELLANEOUS.

1 16 x 5 Plain Head Monito Lathe.
1 13 x 5 Plain Turret Lathe.
1 19 x 6 Plain Turret Lathe.
1 1½ in. Cutting-off Machine.
1 5 in. Cutting-off Machine.
1 30 in. Pulley Lathe.
1 36 in. Gear Cutter.

THE AMERICAN TOOL WORKS CO.,
Cincinnati, Ohio, U. S. A.

EXCEPTIONAL LOT OF

MODERN SECOND-HAND TOOLS.

Engine Lathes.
13 in. x 6 ft. Blaisdell, raise and fall rest.
13 in. x 6 ft. Ames, reverse motion
14 in. x 6 ft. Flather, taper att. and ck.
14 in. x 6 ft. Blaisdell, raise and fall rest.
15 in. x 6 ft. Standard, compound rest.
16 in. x 6 ft. Putnam, raise and fall rest.
17 in. x 6 ft. Prentice, plain rest.
18 in. x 14 ft. Muller, taper attachment.
18 in. x 8 ft. Flather, latest pattern.
20 in. x 10 ft. Perkins, compound rest.
21 in. x 10 ft. Fifield, compound rest.
24 in. x 23 ft. D. W. Pond, compound rest.
25 in. x 12 ft. Putnam, compound rest.
26 in. x 14 ft. Perkins, cpd. rest 2 1-8 hole.
32 in. x 18 ft. Fay & Scott, cpd. rest.
40 in. x 14 ft. Fitchburg, cpd. rest.
40 in. x 20 ft. Fifield, compound rest.

Planers.
16 in. x 4 ft. Hendey, friction.
24 in. x 5 ft. Pond Machine Tool Co.
26 in. x 10 ft. Ferris & Miles.
32 in. x 8 ft. D. W. Pond, two heads.
38 in. x 10 ft. Pond.
42 in. x 12 ft. Fitchburg.
48 in. x 16 ft Putnam Machine Co.
66 in. x 10 ft. Bement.

Shapers.
16 in. Gould & Eberhardt, crank.
15 in. Hendey, imp. style tilting table.
20 in. Prentiss, friction.
24 in. Hendey, friction.

Drills.
Gang Drills, 3 and 5 spindles.
Upright Drills, 20 to 36 in. swing.
Radial Drills, 3 and 4 ft. arms.
Universal Radial, 6 1-2 ft. arm.

Screw Machines.
Garvin No. 1, with wire feed.
Bardons & Oliver, 23-32 wire feed, latest.
Bardons & Oliver, 1 5-32 wire feed, latest.
Jones & Lamson, 1 5-16 wire feed.

Milling Machines.
Brown & Sharpe No. Universal, c'mpl'e.
Cincinnati No. 1 1-2 Universal, bk. gears.
Cincinnati No. 4 Universal, bk. gears.
Brainerd No. 15 Universal, complete.
Garvin No. 11 and 12, with auto. feeds.

Miscel'ne's.
Brown & Sharpe No. 1 Universal Grinding machine, latest, good as new.
Presses—Bliss No. 19 and 20, Stiles No. 2.
Cutting-off machines 2 and 3.
Boiler Rolls, Punches and Shears.
Bradley Hammers, 60 and 200 pounds.

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Lathes, from 12" to 48"; Planers, from 20" up to 60, 48", 54" and 60" Radial Drills; No. 2 Newton Milling Machine; No. 2 Screw Machine; Shapers, from 6" to 30", Boilermakers' Punches, Shears, Edge Planers, Rolls, Drills, Engines, Boilers, Pumps and Dynamos.

FRANK TOOMEY, 131 N. THIRD ST., PHILA.

Boring Bars,

10 inches in diameter, 16 feet long, two heads supported on two housings, driven by worm and worm wheel. Also two smaller bars. Will sell cheap, or trade for other machinery.

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New Goods at Second-Hand Prices.

No. 10A Norris, Bench, swings 10 x 1½ x 1 wheels, $7.50.
No. 10A Norris, Column, swings 10 x 1½ x 1 wheels, $14.
No. 12A Norris, Bench, swings 12 x 2 x 1 wheels, $10.
No. 2 Marion, Bench, swings 12 x 2 x 1 wheels, $11.
No. 2 Marion, Column, swings 12 x 2 x 1 wheels, $17.50.
No. 14B Standard, Bench, swings 14 x 2¼ x 1¼ wheels, $12.50.
No. 3 Challenge, Column, swings 12 x 1½ x 1 wheels and crank shaft, $25.
No. 2 Challenge, Bench, swings 12 x 1½ x 1 wheels, and 2 speed crank shaft, $19.25.
No. 3 Challenge, Bench, swings 14 x 2 x 1¼ wheels and 2 speed crank shaft, $26.50.
No. 2 Challenge, column and counter shaft at'ch'd, wet wheel and surface grinding at., $57.50.
No. 6 Diamond, Column, swings 16 x 2½ x 1¼ wheels and counter shaft.
No. 2 Diamond Water Tool Grinder, complete, with 18 x 2½ in. wheel, counter shaft, pump and truing device.

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SECOND-HAND MACHINERY.

ENGINE LATHES.
1 11 in. x 4 ft. Mann.
1 14 in. x 3 ft. 6 in. Putnam.
1 14 in. x 8 ft. 6 in Prentice.
1 15 in. x 6 ft. Starr.
1 15 in. x 6 ft. W. & L.
1 16 in. x 7 ft. D. & H.
1 18 in. x 8 ft. D. & H.
1 27 in. x 10 ft. D. & H.
1 32 in. x 13 ft. Bement.
1 48 in. x 18 ft. G. & S.
1 48 in. x 16 ft. Fifield.

PLANERS.
2 16 in. x 16 in. x 4 ft. Hendey.
1 24 in. x 24 in. x 6 ft. Powell.
1 28 in. x 28 in. x 8 ft. G. & S.
1 30 in. x 30 in. x 8 ft. S. & S.
1 30 in. x 30 in. x 10 ft. Niles.
1 32 in. x 26 in. x 12 ft. Gray.
1 36 in. x 36 in. x 12 ft. Powell.
1 36 in. x 36 in. x 18 ft. Sellers.
1 54 in. x 54 in. x 20 ft. Niles.

SHAPERS.
1 9 in. traveling head, Wm. Sellers.
1 13 in. Traveling Head, Bement.
1 16 in. G. & E., triple G.
1 16 in. G. & E., single G.

DRILLS.
1 34 in. Harris, Bk. G.
1 32 in. L. & D.
1 3 spindle Hendey.
1 No. 3 4-spindle Garvin.
1 6-spindle Quint.
4 Suspensions, Pond.

SCREW & CHUCKING MACHINES.
1 No. 2 P. & W., plain,
1 No. 1 Costello, wire feed.
1 No. 2 Costello, wire feed.
1 No. 2 1-2 P. & W., wire fd.
1 No. 4 Windsor, plain,
1 No. 4 Windsor, wire feed,
1 No. 2 Niles.
1 18 in. P. & W. Chucking Machine

MISCELLANEOUS.
1 P. & W. Grant Pattern Miller.
1 48 in. Niles C. W. Borer.
1 48 in. Industrial C. W. Borer.
1 72 in. Niles B. & T. Mill,
1 3 ft. Riveter, "Portable."
1 No. 2 P. & A. Cyl. Borer,
1 10 in. New Haven Slotter.

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Cleveland Automatic Screw Machines.
Garvin Bicycle Hub Machinery.
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Ferracute Power Presses, dial and roll feed.
Full particulars and prices on application.
Retiring from business.

THE MOORE CYCLE FITTINGS CO.,
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U. BAIRD MACHINERY CO.

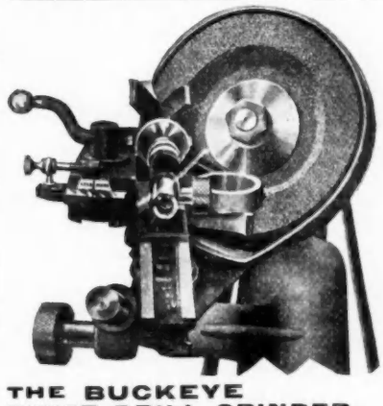
523-525 Water St.; 524-526 First Ave.,

PITTSBURGH, PA.

MACHINE TOOLS.

SECOND-HAND TOOLS.

One 36 in. x 28 ft. Betts Engine Lathe.
One 24 in. x 10 ft. New Haven Engine Lathe.
One 21 in. x 7 ft. Lodge & Davis Turret Lathe.
One 15 in. x 5 ft. A. T. & M. Co. Fox Lathe.
One 30 in. x 30 x 7 ft. New Haven Planer.
One 26 in. x 26 x 7 ft. New Haven Planer.
One 48 in. A. Box & Co. Radial Drill.
One 36 in. Gould & Eberhardt Spur Gear Cutter.
One 19 in. Putnam Slotter.
One 10 in. New Haven Slotter.
One 48 in. Pulley Borer.



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Made in two sizes and four styles.
Grinds from No. 60 to 2 inches.
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We have rented

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Almost two hundred machines in stock.

Do not fail to write us before purchasing.

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Almost New Machine Tools

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SECOND-HAND PRICES.

1 84 in. x 18 ft. Engine Lathe.
1 26 in. x 14 ft. Fitchburg Engine Lathe.
1 English Slotter, 14 in. stroke.
1 Universal Radial Drill, 5 ft. arm.
1 63-in. Pond Vertical Boring Mill.
1 6-ton Single-Acting Steam Hammer.
1 2-ton Double-Acting Steam Hammer.
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1 Helve Hammer.
1 No. 7 Hilles & Jones Shear.
1 Morgan Electric Crane, 15 tons.
3 Dynamos.

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14 in. x 6 ft. Porter.
14 in. x 6 ft. Blaisdell, rise and fall rest, 9 in. chuck.
14 in. x 6 ft. Wright & S., rise and fall rest and 8 in. chuck.
15 in. x 6 ft. Bogert.
15 in. x 6 ft. Reed.
15 in. x 8 ft. Prentice, rise and fall rest.
15 in. x 8 ft. Pratt & Whitney, rise and fall rest.
16 in. x 5 ft. Hand Lathe, 3-4 in. drill chuck, swivel vise, milling attachment, slide rest, extra head for milling.
16 in. x 6 ft. Blaisdell, rise and fall rest.
16 in. x 6 ft. Prentice, rise and fall rest, 14 in. chuck.
16 in. x 8 ft. Pratt & W., rise and fall rest.
26 in. x 10 ft. Blaisdell, comp. rest.
26 in. Stevens Pulley Lathe.
50 in. Stevens Pulley Lathe.
2 Lodge & Davis Fox Lathes.

PLANERS.
Blaisdell Crank Planer.
16 in. x 16 in. x 3 ft. Pratt & W.
20 in. x 20 in. x 6 ft. Pease.
26 in. x 26 in. x 6 ft. New York Steam Engine Co.
36 in. x 30 in. x 8 1-2 ft., maker not known.
42 in. x 12 ft. Richards, open side; weight, 42,000 lbs.

DRILL PRESSES.
No. 2 Pratt & W., 4-spindle.
1 10 in. Stover, 6-spin. tur. drill.
2, 3 and 4 spindle Garvin Gang Drills.
1 4-spindle Ames.
7-spindle Adt. Drilling and Countersinking Machine.
9-foot Holly Radial Drill.

MILLING MACHINES.
No. 0 Universal, Garvin.
No. 2 Kempsmith.
No. 2 Garvin, plain.
No. 4 Garvin, rack feed, without arm.
No. 11 Garvin, vertical attach.
No. 2 Garvin auto. Sprocket Wheel Miller.
50 in. Brainerd Keyseater.
Pratt & Whitney Circular Miller.
Ames Hand Miller.
Niles Power Miller.
Lincoln Miller for sprocket wheels.

SCREW MACHINES.
1 21 in. x 6 ft. Flather Turret Lathe, back gears and auto. feed to turret.
1 14 in. Garvin Turret Lathe, with pan.
1 Garvin No. 1, wire feed.
1 Brown & S. No. 1 wire feed.
1 Garvin No. 2 1-2, wire feed.
1 No. 2 Pratt & Whitney, plain.
1 No. 3 Pratt & Whitney, w. f.
No. 3 Garvin, fric. head, 2 jaw chuck.
1 No. 2 Wind-sor, w. f., chasing bar and tools.
1 No. 4 Warner & Swasey, geared fric. head, oil pump and 2 jaw chuck.
1 x 8 Jones & Lamson, plain, with 2 jaw chuck.
2 Pratt & W. Hub Machines, geared fric. head, oil pump and 2 jaw chuck.

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18 in. Wood & Light, traverse.
12 in. Crank, Juengst.
15 in. Hendey.
24 in. Hendey.

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2 H. P. Nash Gas Engine, with sound deadener, gas bags, etc.; 3 1-2 H. P. Erie Gas Engine; 1 No. 2 Garvin Auto. Tapper; 1 Garvin Boring Mill; 140 in. Boring and Turning Mill, 1 Head, new; 1 American Gas Furnace; 1 28 x 16 x 52 in. Springfield Surface Grinder; 1 Garvin 1-Spindle Profiler; 1 No. 3 Garvin Cutter Grinder.

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Mill and Cutter Grinder.

With this machine Cutters, Taps, Reamers, Lathe Tools, etc., can be ground. Cutters to 6 inches in diameter, both spiral or straight. Reamers 14 inches and less in length.

IS ARRANGED FOR TWO WHEELS.

A Machine needed in every Tool Room.

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$62.00.

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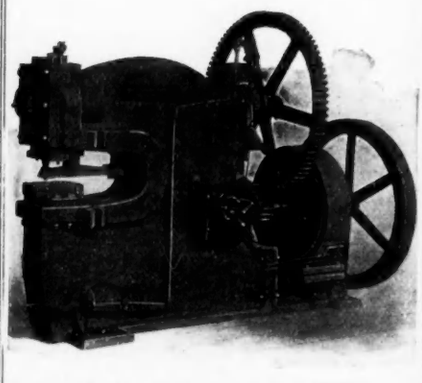
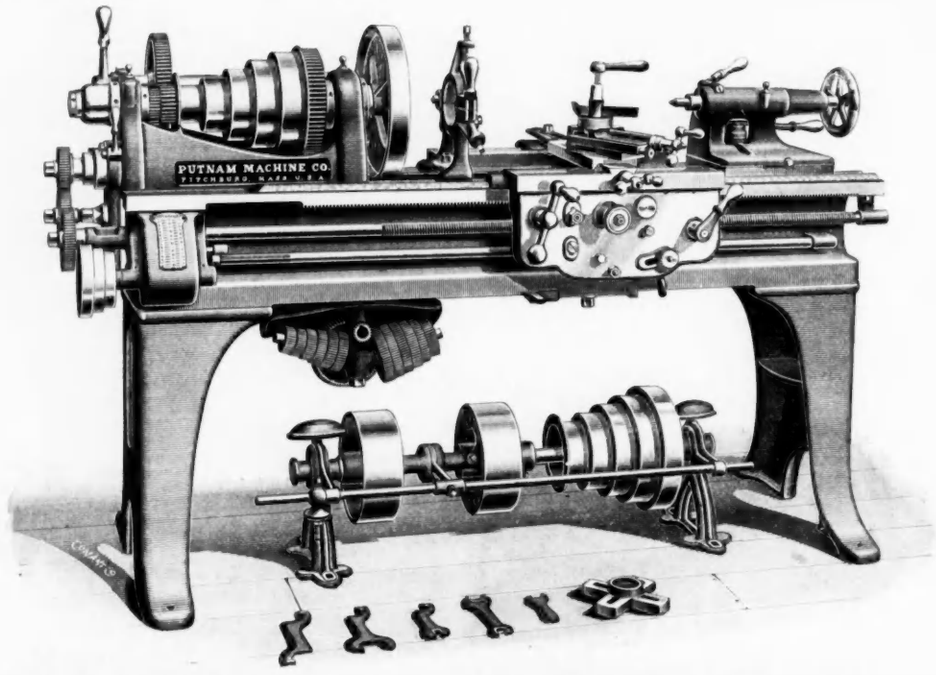


BULLOCK ENCLOSED MOTOR.

CINCINNATI, O.



Sizes :

13 in., 14 in.,
15 in., 17 in.,
19 in., 21 in.,
25 in., 28 in.,
with new and novel features peculiar to this make.

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LARGE HOLLOW SPINDLE,
5 SECTION CONE,
AUTOMATIC STOP,
PATENT TAILSTOCK.

"98" Pattern 14 in. x 6 ft. Putnam Engine Lathe.

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TWIST DRILL AND MACHINE CO.,
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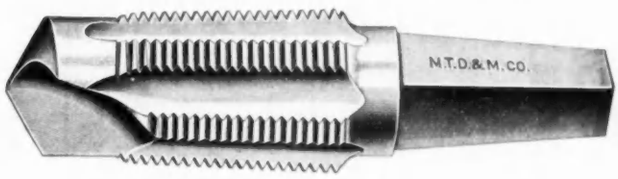
We are manufacturers of

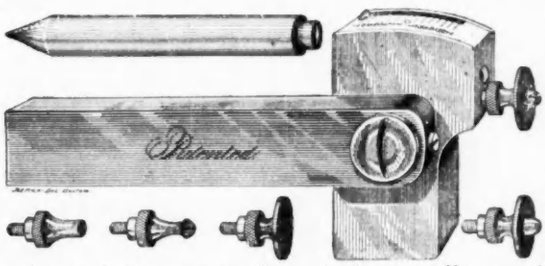
TWIST DRILLS, REAMERS, MILLING CUTTERS, CHUCKS, TAPS AND DIES AND MACHINISTS' TOOLS.

A work of real merit finds favor at last. A. B ALCOTT.

COMBINED PIPE TAP AND DRILL.



FOR TAPPING GAS AND WATER PIPES.



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for testing the truth and alignment of machine parts; a variation of 1-1000 of an inch moves pointer 1-12 or 1-6 of an inch according to leverage used; indicates either horizontal or vertical movement A good tool to have.

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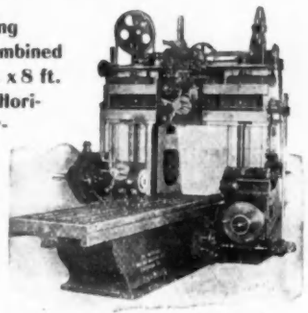

THE INGERSOLL MILLING MACHINE CO.,
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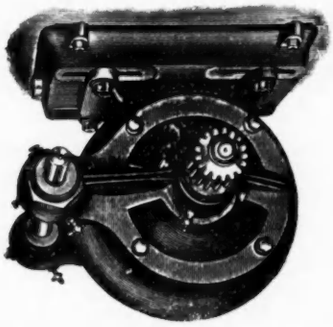

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ANY SLOW SPEED.

WHOLLY ENCLOSED. DIRT PROOF.
WATER TIGHT. NO FLOOR SPACE NEEDED.

INVERTABLE and ADJUSTABLE to any POSITION immediately without loosing a bolt or nut.

Also full line MULTIPOLAR GENERATORS up to 150 K. W.

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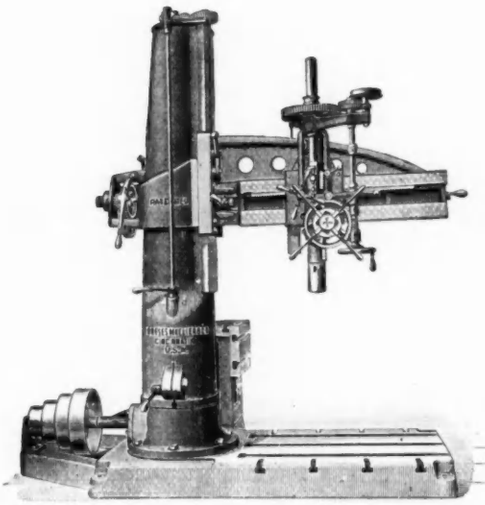

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OUR NEW RADIAL DRILLS

ARE LEADING.

THE LEVER in front of operator **STARTS, STOPS, ENGAGES** the **BACK GEARS** and **REVERSES** quick for **TAPPING**—all while the machine is running.

NEW QUICK RETURN. NEW FEED DEVICE.

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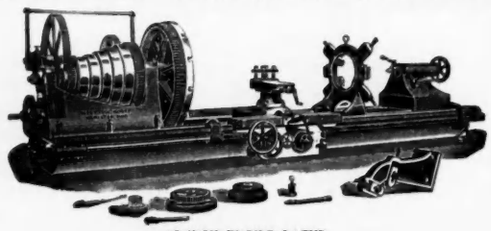

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ENGINE LATHES ∴ FORGE LATHES
∵ TURRET LATHES ∵
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Modern Machine Tools. .. .. Catalogue Free.
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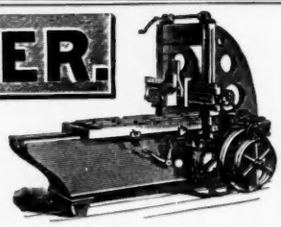

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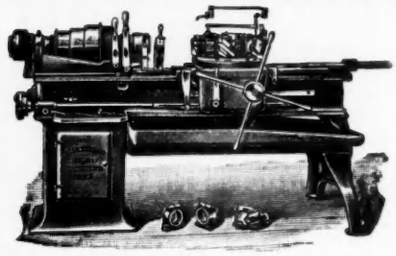
Manufacture Planers as an exclusive specialty.
Planers only! Nothing but Planers!!



The Flat Turret Lathe
Does Lathe work accurately up to 2 in. diameter by 24 in. long.
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William Sellers & Co. Incorp.
PHILADELPHIA, PA.
MODERN TOOLS FOR MODERN METHODS.
PULLEYS and SHAFTING. Boring Mills Bending Rolls, Bolt Cutters, Cranes, Lathes, Planers, Slotters, Punches and Shears, Mechanical Stokers, Turn-Tables, Testing Machines, Etc. INJECTORS for ALL SERVICE.

"Constant Angle" Twist Drills.

Accurate, Durable, Efficient.
THE T. & B. TOOL COMPANY,
Catalogue free. Danbury, Conn., U. S. A.

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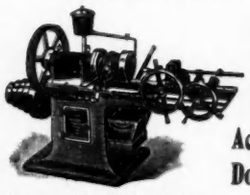

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Acme Bolt and Rivet Headers.
Acme Single, Double and Triple
Automatic Bolt Cutters. Cutting from 1-8 in. to 6 in. Diameter.
Also Separate Heads and Dies.

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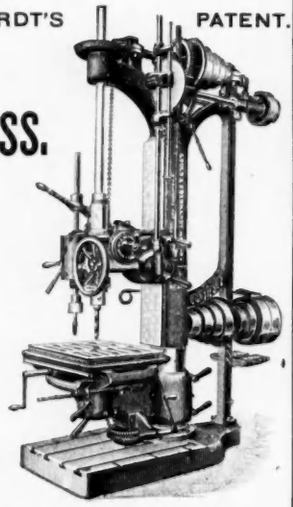
With Patent Automatic Tapping Attachment and Compound Tapping Table.
LABOR SAVING.
Modern Machine Tools.



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Ask us good, hard questions about these bearings, their uses and costs.
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GEAR WHEELS and Gear Cutting of every description.
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